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Getting the Most Out of Your Machine Tool Dollar

By D. C. Wright

H. W. Caldwell & Son Co. Plant of Link-Belt Co.

Some reasons why the average manufacturing plant cannot employ all of Mr. Smith's* principles to advantage — Three classes of plants and their respective problems

SOME years ago, when the writer was somewhat intimately associated with the activities incidental to a complete revision of the manufacturing policy and methods of a well-known builder of motor vehicles, Henry Ford put forth his then revolutionary edict that five dollars constituted a proper minimum wage in the industry.

At that time one of the older spirits in the organization bewailed the fact that Mr. Ford by his new methods had found a sure way of driving all of the other motor car makers to the poor house, the theory being that such a practically guaranteed wage was prohibitive to those not organized as Ford was on a large quantity production basis. It is now over ten years, however, since that bomb-shell was unloosed upon the automobile industry and yet the magazine advertisements and "motor rows" of our cities seem to indicate that quite a few of the car builders managed to survive the onslaught of Ford's ruinous wage scale.

Along this same line, we have probably all of us heard people critically compare certain methods and layouts, perhaps of our own plants, with the methods or layouts in the Ford plants, and we in our defensive arguments have felt that these people were unfair because of the vast differences existing between the average metal trade industrial plant and such mighty enterprises as the Ford shops.

With this as an introduction let me say that accepting Mr. Smith's* statement as indicating fairly well the particular and peculiar elements in connection with the production operations at the Schenectady works, I can see where the general method for machine tool control outlined in Mr. Smith's article would serve admirably to keep the decks cleared of worthless equipment. On the other hand, unlike the plant cited, the ordinary manufacturing concern cannot hope to unload so freely and by disposal through readily-accessible channels keep its stock of idle or obsolete machines at a minimum.

There is no question about the desirability of disposing of any machine tool which through actual abuse or wear has attained the point where it is impossible to rely upon the quality of its performance.

On the other hand, the ordinary run of manufacturing plants are compelled by the nature of their business to go at this question of renewal or replacement of machine tools from an entirely different basis from that which a plant like the General Electric Co. Schenectady Works is privileged to take. It is true that the final causes for machine tool replacement are in all cases the same as those that Mr. Smith names, but the values of the various elements in the formulas used vary materially under different programs of production and company policy.

One of the biggest points to be considered, when dealing with this matter of machine tool replacements, is that of whether a plant is producing a standard product on a quantity basis or devoting its efforts to work of a more or less special jobbing nature. To these two main classifications might be added the third major possibility pointed out by Mr. Smith, wherein the work actually done in the plant was merely in the nature of development, with designs, tooling and methods being worked out to a sound basis and then the whole outfit transferred in its entirety as a "going" concern to some other location.

After this latter point has been reached, the proposition usually falls into the first of the two major classes previously mentioned, that is to say, it becomes a proposition involving the production of a standardized product. In the case of a manufacturing program of this first class, where the entire activity revolves about the production of a more or less standard line of repetitive work, the question of tool replacement is one to be

*The reference is to the first of the articles under the title "Getting the Most Out of Your Machine Tool Dollar," by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., published in Vol. 62, page 409.

answered through a comparatively simple process of reasoning. It may be a matter of an improved process or a simplified series of manufacturing operations, which justify a rearrangement of tools or the substitution of different tools for those formerly used without in any way reflecting upon the respective merits of the machines involved, when judged from the standpoint of their individual performance or capability.

Or again, it might reasonably be possible that the natural development in machine tool practice should bring upon the market a new line of tools which through their ability to produce work in a more efficient manner would literally compel their substitution for equipment which prior to this time had been deemed satisfactory, and which perhaps even now is in first-class condition mechanically and with years of good service ahead, if it could be profitably applied.

Special Purpose Machines and Replacement

Again, such a production problem is of the nature that brings forth tools of the "special purpose" design, unique in their application to the industry, and these of course are usually not confronted with much that is competitive in the way of efficiency as far as the general machine tool trade is concerned. Here once more may be brought in the question of the desirability of replacements, but unless it is a question of actual deterioration due to mechanical wear, the competition is entirely in the hands of the development men and designers connected with that particular industry.

Different indeed, however, is the situation of the general manufacturing plant where there may perhaps be a certain number of products which because of their combination of salability and adaptability to economical production on the machine equipment available, are considered "stock" and produced on a quantity basis. Such plants, however, look for their main business to "outside" jobs, involving perhaps complete combinations of engineering, structural, transmission and manufacturing equipment, for the real justification of their existence.

Here, ability to bid successfully for business frequently involves the ability to handle not only the design, but all stages of pattern, foundry, machining, assembling and erection work; and the complete proposition is likely to carry with it machining operations ranging from small screw machine work to massive frame construction, necessitating the employment of the larger type of planer and boring mill equipment. Lucky indeed is such a plant when a proposition of this nature carries with it the final working up of design details as this permits the engineer to adapt the details as far as possible to what tool equipment he may have available.

More often, however, jobs of this sort are turned over to competitive bidders as complete designs, represented by prints of the whole equipment desired, and very little, if any, option allowed the manufacturer in the way of modification of details to meet his production ability. It is therefore entirely a case of reviewing his available equipment and deciding how he can most economically produce the desired result with what tools he has.

For the reasons illustrated almost any plant in the second of the two major classes originally mentioned has in its plant equipment a number of tools which perhaps are used only a small proportion of the time and yet whose retention is desirable through the greater latitude afforded to that plant in its ability to "figure" on new business. Their value lies in their ability to perform certain operations or "swing" certain extraordinary sizes of work rather than in their efficiency in performing these operations on a "long run" basis or in competition with a more modern tool.

Occasionally the opportunity arises for absorbing the cost of a new and modern tool on some job, where the particular operations to be performed on this tool occur in sufficient number to make the gross savings affected over any possible method with already available equipment justify the investment. Generally speaking, however, the average plant, bidding for miscellaneous business, must adopt a very flexible policy toward its equipment program.

The individual tool records, covering costs, running repairs, maintenance, productive operating hours, class of work handled, etc., as mentioned by Mr. Smith, are always to be recommended in any case, and few progressive modern plant managements allow themselves to be without them nowadays, but back of all the systematic helps in the matter of tool replacement and maintenance there must always exist the broad-minded judgment of some individual capable of considering each case "on its merits."

Individual Cases Must Be Considered

While the exercising of this judgment is a comparatively simple matter in the case of mass production of repetitive work, and can be largely reduced to the application of simple formulas, it becomes increasingly a question of individual cases as the scope of a plant's activities broadens into the field of general engineering and jobbing work. Such a plant might very well possess an old relic of a cone-driven 20-ft. boring mill, which from the standpoint of a comparison with modern tool efficiency would be incomparably inefficient, but if this large tool on occasional set-ups enabled this plant to figure on jobs that other plants with only medium or small-sized mills had to pass up or sub-contract, who can say that this outfit should properly be scrapped?

Some plants regularly figure on expending the amount of their annual machine tool depreciation, less maintenance costs, on new equipment, and the writer is not so sure that under proper administration a modification of this rule isn't about as good as any for a general manufacturing plant to follow. At all events, while the plan and policy laid down by Mr. Smith for the Schenectady works of the General Electric Co. is based upon the soundest of general principles, and without a doubt fits the peculiar conditions under which that plant operates, there are certain very limiting elements present which make it to a large extent impossible of ready application in other plants not similarly conducted.

In other words, this matter of machine tool replacement is like the application of so-called "scientific management" and a lot of other things, a bully good principle but one which must be dressed up to fit individual cases if the best results for any particular set of conditions are to be arrived at.

[The preceding article is the sixth under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published on page 409, Vol. 62. The second by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521, Vol. 62. The third, by Robert F. Runge, Vice-president of SKF Industries, Inc., was published on page 719, Vol. 62. The fourth, by L. C. Morrow, Managing Editor, *American Machinist*, outlining the policies of the International Harvester Co., was published on page 793, Vol. 62. The fifth, by G. T. Christopher, Factory Manager, the Dayton Engineering Laboratories Co., was published on page 907, Vol. 62. Other articles on the same subject will be published in forthcoming issues.]

Automotive Production

Forging Crankshafts for Large Diesel Engines

By Fred H. Colvin
Editor, *American Machinist*

Some of the problems in producing heavy crankshafts in fairly large quantities and the methods by which satisfactory, uniform results are secured

ONE of the principal reasons for the rapidly increasing interest in Diesel engines is the greater dependability of these engines on account of the improved manufacturing practices used in building them. The progress in this field is similar to that in the automotive field, and the refinements in production methods are comparable with those used in building the finest automobile engines.

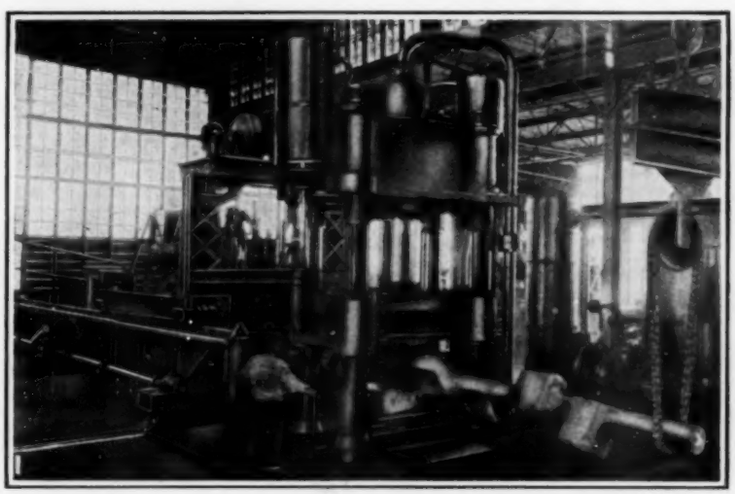
As an illustration of the methods that are used in building Diesel engines, the practice of Fairbanks, Morse & Co., at its Beloit, Wis., works will be taken up in a series of articles of which this is the first.

Builders of Diesel-type engines have discovered that the crankshaft is one of the many parts that must have most careful attention in all stages of its manufacture. With this knowledge as a guide, a method of forging crankshafts has been worked out that is giving excellent satisfaction and that allows the forgings to be made in a short time in comparison with the usual practice.

The crankshafts are made of 45-point carbon steel, the material being received in billets or blooms and then forged to shape in a 1,000-ton hydraulic press built by the United Engineering Co. This press, together with the mechanism for handling the piece being forged, is shown in Fig. 1. A close up of the press is shown in Fig. 2, where a large shaft is being finished.

The billet or bloom is heated in huge oil-fired furnaces, near the forging press, drawn out by suitable handling mechanism and forged in the press. The weight of a billet is about 6 tons and the shaft as forged, is about 23 ft. long.

After forging the three throws so that they come opposite, or 180 deg. from each other, the next step is to twist the shaft at two points so that the three pairs of cranks will be 120 deg. apart. The twisting is done by heating the neck, or bearing, of the shaft between the throws and holding one of the throws in a large hammer, the twisting being done by the hoist on a jib crane.



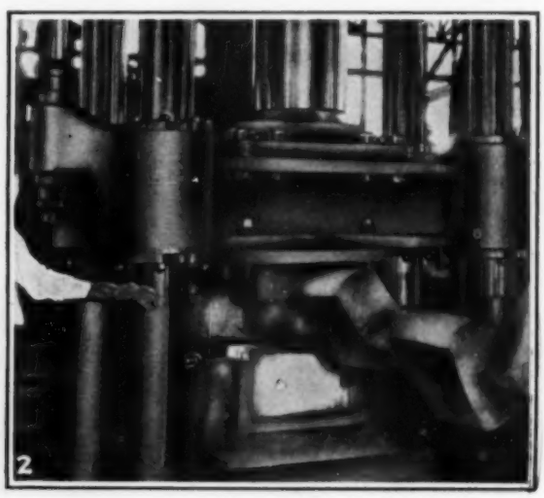


Fig. 1—The 1,000-ton forging press. Fig. 2—Close-up of forging press

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Fig. 3—Heating before twisting. Fig. 4—Heating 6-throw shaft in furnace

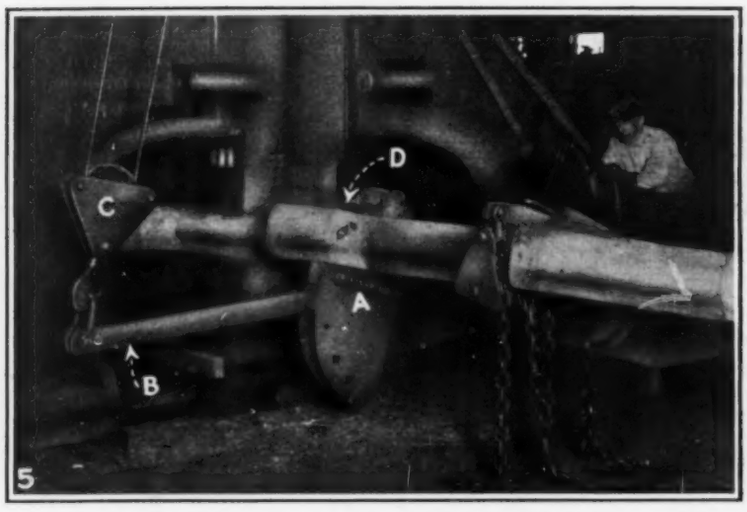


Fig. 5—How the shafts are twisted. Fig. 6—Checking angles of cranks

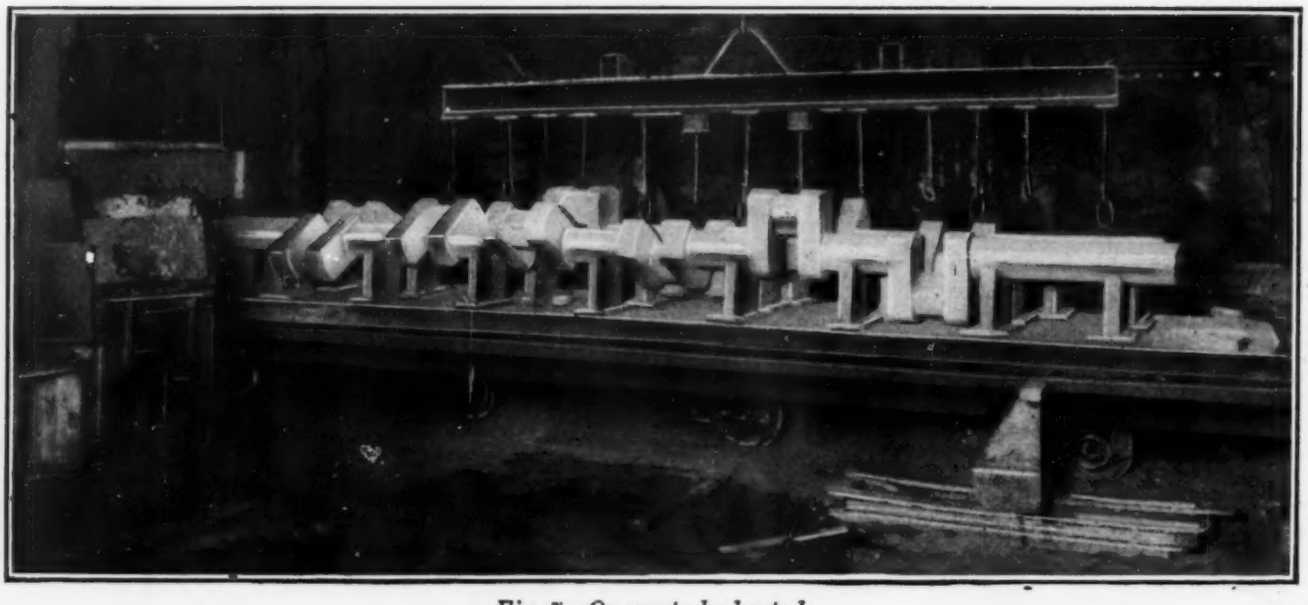


Fig. 7—On car to be heated

AUTOMOTIVE PRODUCTION

In Fig. 3 a smaller 3-throw shaft is being heated for twisting in a built-up furnace, while Fig. 4 shows the large forging furnace being used for heating a 6-throw crankshaft. The method of twisting is shown in Fig. 5. One of the throws is held between the hammer head and the anvil while the clamp *A* is hooked over the next throw and, the jib crane pulls up on the lever *B* by means of the wire rope and pulley block *C*, until the desired twist has been given. The clamp is heavy but is easily handled by means of the loop shown at *D*, and drops off easily after the twist is made.

An angle gage, shown in Fig. 6, enables the hammerman to know when the throws are at the proper angle. After the crankshaft has been twisted, it is necessary to align the throws and get the shaft straight before it cools.

The crankshafts are then rough turned and brought back to the forge shown for heat-treatment. They are placed on cars as in Fig. 7, the shafts being carefully supported at each bearing on iron V-blocks, and the cars run into the furnace. Here they are heated to approximately 1,500 deg. F. for 12 hr., and quenched in oil in the tanks shown in Fig. 8. Both Figs. 7 and 8 show the way in which the crankshafts are handled so as to avoid springing. The hooks in Fig. 8 show how each bearing is supported and how the shaft is lowered into the tank. When it is remembered that the crankshaft, as shown, weighs between 4,500 and 5,000 lb., the need for the crane becomes all the more apparent.

When the crankshaft has been heat-treated and before it goes back to the machine shop to be finish turned, a test bar is cut out of the end and sent to the laboratory for test and examination. Fig. 9 shows how this is done. A husky, horizontal drilling-machine drives a hollow drill into the long end of the crankshaft, and removes a test bar of approximately the desired size for laboratory use. If the test is satisfactory the shaft is stamped and the test recorded for future reference.

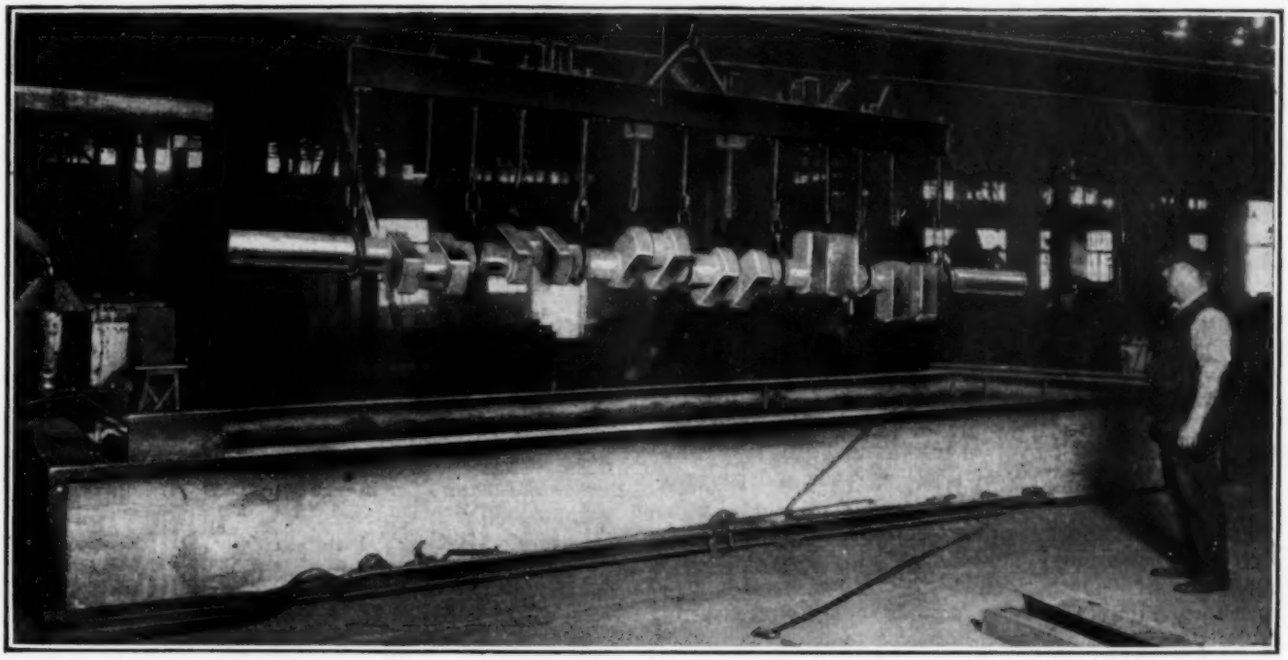


Fig. 8—Ready to quench

Should the test piece fail in any particular, the crankshaft goes back for further heat-treatment to bring it up to the specification. Long experience in handling work of this character, however, makes such an occurrence extremely rare. With the passing of the crankshaft by the inspector, it goes to the machine shop for finishing.

Before leaving the forge shop, however, it may be noted that the crankshaft forgings handled vary from 2 lb. in weight, for small pumps, to about 12,000 lb. for the largest 6-throw crankshaft having 10-in. pins for Diesel engines. There are also a great variety of forgings of other kinds made in this shop, many of them now being made in bulldozers or other types of forging machines best suited for the particular kind or shape of the forging wanted.

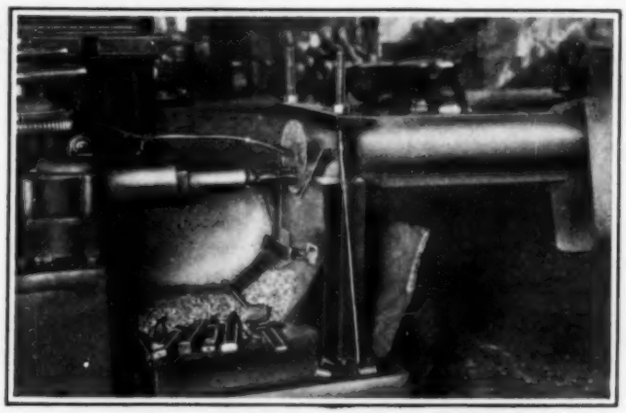


Fig. 9—Drilling out a test bar

Book Reviews

Modern Gaging Practice. By Albert A. Dowd and Frank W. Curtis. Clothboard covers, 280 pages, 6x9 in., illustrated. Published by the Engineering Magazine Co., 116 West 32d St., New York, N. Y. Price $3.

The book contains a fund of interesting as well as useful information on the subject of interchangeable manufacture and methods of control. There are many working-drawing illustrations showing how actual gaging problems have been solved in the field, together with charts and data on correct practical allowances, tolerances and limits. There is help in its pages for the engineer and the draftsmen from the standpoint of design, for the superintendent and his foremen and toolmakers on the building of gages, and for men, in various departments, that are responsible for the quality of the product.

Interchangeable manufacture is defined from a practical standpoint, the limit system is discussed, and correct and incorrect methods brought up and illustrated on the subject of dimensioning drawings. The three classes of gages, standard, work, and inspection are taken up in turn, and the designs of many varieties drawn in detail. The application of gages for controlling the manufacture of screw threads and gears is gone into rather thoroughly.

There is a separate chapter devoted to the description of the inspection methods of a successful machine-tool manufacturer, another on final testing, which incidentally should be better understood by the purchaser of equipment, and finally the discussion of tolerances principally in the form of tabulated charts. Throughout the test are points on tool design, hints to excellent toolroom and machine-shop practices, descriptions of manufacturing methods and set-ups for control, all the result of actual experience on the part of the authors. The experiences can be turned to advantage in many directions. The book is recommended.

Mechanics of Machinery. Kinematics and Dynamics. By Robert C. H. Heck, Prof. of Mech. Eng., Rutgers University. Five hundred fifty pages. Illustrated. Published by the McGraw-Hill Book Co., Inc., New York City. Price $5.

The second part of Prof. Heck's exhaustive treatise on the mechanics of machinery is apparently well up to the high standard for completeness of treatment set by the first part which was published some months ago. This volume starts with the kinetics of displacement, velocity and acceleration and continues through the graphics of machine forces; the mechanics of the piston engine; vibration, balance testing and gyrostatic action; friction and lubrication; engine governors. A number of unusually good problems are used to bring out some of the difficult points.

Primarily a college textbook this volume contains up-to-date information that should earn it a place on many a reference shelf. It has been laid out so that long or short courses in various divisions of the subject can be selected depending on the limitations that surround the instructor.

One thing that appeals in the treatment of the subject is a paragraph at the beginning of each section in which the author outlines briefly the ground to be covered in that section. Another ingenious device is the reference schedule on the last page of the book that permits one to locate any figure or equation very quickly, a useful factor in reference work. Some of the proofreading, unfortunately, it not so good as it might be.

Throughout the book minor details that can be had in full from technical bulletins, magazines, and society publications have been touched on lightly, the reader being given the source reference for his use if he desires more exhaustive information.

The Engineering Index—1924. Seven hundred eleven 6x9-in. pages. Published by the American Society of Mechanical Engineers, New York City. Price $6.00 to members, $7.00 to non-members.

The index refers to over 1,300 periodicals, reports and other publications, and by its use an engineer can keep in touch with the data in periodical publications of the world for 1924. There are over 17,000 carefully selected items, approximately 20 per cent being cross-references.

In connection with the Index, is a photostat service by which any purchaser may secure copies of articles desired. Each book carries 50 coupons entitling the holder to a 20 per cent reduction on the price of photostats ordered. Such a service is of greatest value to those who do not have access to large libraries.

Personal Leadership in Industry. By David R. Craig and W. W. Charters. Two hundred forty-five pages, 5½x8 in. Published by the McGraw-Hill Book Co., New York City. Price $2.50.

The number of books being published that deal with the personnel problem in some form or other, is of great interest to all who recognize this as a most important factor in industry. The frequent appearance of such books is a hopeful sign that more attention is being paid to this phase of management and that something besides time study and cutting speeds is being considered by those responsible for production.

It is difficult to give an adequate idea of the helpful suggestions contained in this book without quoting liberally from various sections. The seventeen chapters divide the various angles of the question to be considered into convenient groups, and these are again subdivided by bold-faced heads into topics that catch the eye and are easy to read.

Among the subjects considered are forcefulness, prestige, personal interest, leading without bossing, teamwork, kindliness without weakness, the reprimand, self-confidence, self-training and other interesting topics. The last chapter contains a statement as to the procedure to be used in developing leadership.

Instruction for Care and Operation of Transformers. Thirteen pages, 6x9 in. Published by the Electric Power Club of Cleveland, Ohio. Price 25c.

This is the third edition of an instruction book, which speaks well for its popularity and value. There are two parts, one dealing with power transformers and the other with distribution transformers of smaller capacities. The two sections seem to contain about all the information needed in handling transformers of both types. For, while transformers require less care than almost any other type of apparatus, there are certain fundamental requirements that lead to trouble if they are neglected.

Photoelasticity and its Relation to Gear Wheels

By A. L. Kimball, Jr.
Research Laboratory, General Electric Co.

Methods and instruments used in determining stress distribution on gear teeth under static load—Results of stress in celluloid models easily transferred to steel

UNTIL the photoelastic method was developed, no practical method had been found for determining the stress distribution in loaded bodies of irregular shape. It had long been known that transparent materials when stressed, become doubly refracting so that the light passing through them is altered, but it remained chiefly for Prof. E. G. Coker, of the University College of London, to so apply this double refracting property of transparent materials, that immediate practical results could be obtained in stress measurements. Thus a heretofore difficult problem has been satisfactorily solved.

Briefly, the photoelastic method is a means by which the stress in loaded structures can be directly determined by polarized-light measurements on transparent models. Polarized light is produced in the usual way, and is passed through the transparent model, which alters the light in proportion to the stress at each point. When the transmitted light is passed through a suitable optical device, it may be projected upon a screen or upon a photographic plate, where suitable analysis of the colored image will give the exact stress distribution in the transparent model.

Presented at the ninth annual meeting of the American Gear Manufacturers' Association, Pittsburgh, Pa., May 6 to 9, 1925.

The process of measuring stress by the photoelastic method may be divided into three parts:

1—The construction of a transparent model of the body in which the stress distribution is to be found, of the same geometrical form as the body.

2—The measurement of the stress distribution in this model by means of polarized light.

3—The translation of this stress distribution from the model to the original body.

The models are usually made from transparent celluloid sheets, from $\frac{1}{16}$ to $\frac{1}{2}$ in. in thickness. Celluloid is comparatively easily machined and has a reasonably-high optical constant, so that the required colored images can be obtained without the production of excessive stresses. Other materials such as glass or glyptol may be used, but thus far they have not been found to be as practical as celluloid. Celluloid has the disadvantage that it is apt to dry along freshly cut boundaries, thus producing internal stresses. This difficulty may be avoided by making measurements as soon as the model is cut, or by keeping the model in an air-tight box containing some shavings of the same kind of celluloid as the model, so that a sort of balance of vapor pressure is maintained. The model has to be machined with care to prevent heating, a

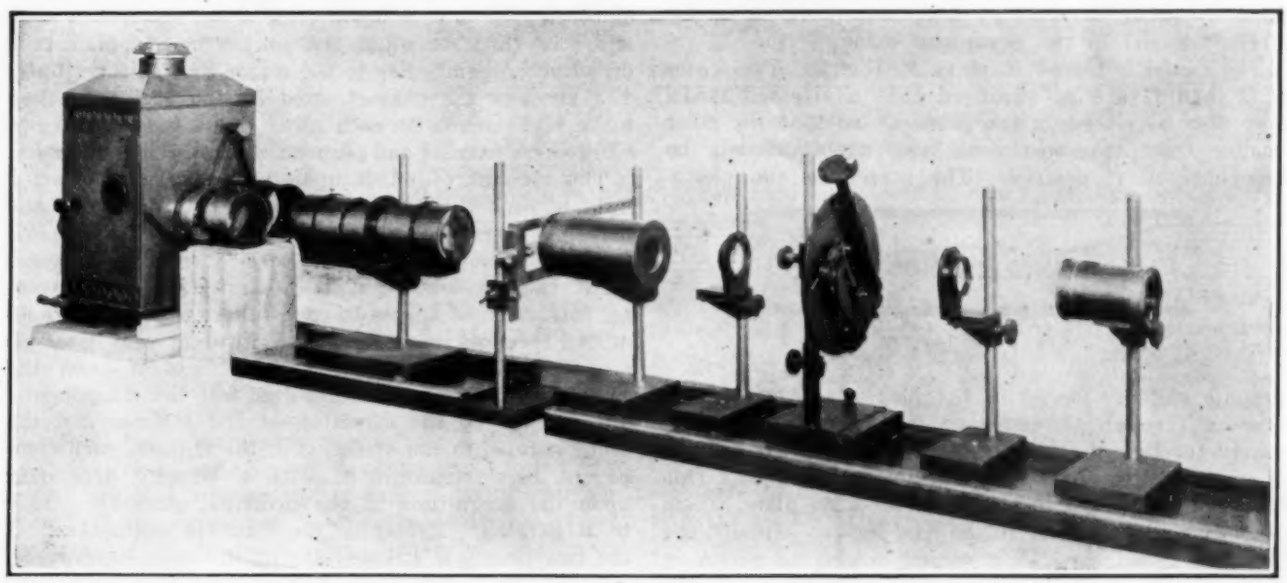


Fig. 1—Optical set for stress determinations

small amount of which always produces edge stresses.

The stress measurements are made by means of a special optical set such as that shown in Fig. 1. This apparatus was designed by Prof. Coker and the writer, for the General Electric Co., and made by Adam Hilgar, of London, in the year 1920, and has been in constant service ever since.

Light from the source *A*, Fig. 2, passes through the

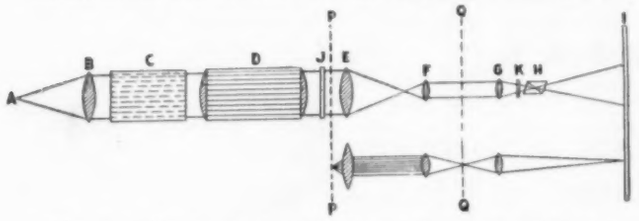


Fig. 2—Diagram of optical set, showing path of light rays

condensing lens *B*, water screen *C* and the polarizer *D*. The polarizer is shown in more detail in Fig. 3. The light is converged to a narrow pencil of rays which passes through a Nicol prism of calcite. A water screen is necessary to prevent the prism from becoming overheated. When the light emerges from the polarizer it is plane polarized, or vibrating in one plane, as shown in Fig. 4, to the left.

But plane-polarized light is not suitable for stress measurements because it is affected differently, depending upon whether the stress in the model is parallel or perpendicular to the light vibrations. The plane-polarized light is therefore passed through the quarter-wave plate *J*, Fig. 2 (shown enlarged in Fig. 4), which alters it so that it is circularly polarized. The quarter-wave plate is made of a piece of doubly-refracting crystal that transmits vibration components in the direction *AB* with a different velocity from the components perpendicular to it. The plate is of such a thickness that one component is retarded one-fourth of a wave length behind the other so that when they combine, circular vibrations are produced as shown in Fig. 4 at the right.

It is circularly-polarized light that is used for stress analysis. Because of its symmetry, circularly-polarized light is equally altered for all angular positions of the stressed model in the equatorial plane.

The model is placed in plane *P*, Fig. 2. The lenses *E*, *F* and *G* are so arranged that a stressed model may also be placed in the plane *Q*, so that the color images from two specimens may simultaneously be superimposed if desired. The screen or the photo-

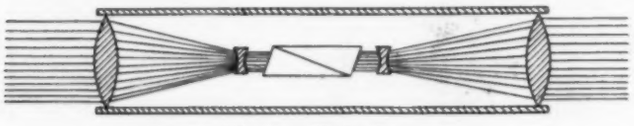


Fig. 3—Polarizer

graphic plate is placed in the plane *I*. After transmission through the stressed members, the light is passed through the quarter-wave plate *K* with its axis at right angles to the quarter-wave plate *J*. This cancels the effect of the first quarter-wave plate, which otherwise would appear in the final image. Finally, the light is passed through a second polarizing prism or analyzer, after which it is brought to focus on the screen, producing a colored image of the stressed specimen or specimens, the order of color of which at all points gives an accurate measure of the stress at the corresponding point in the specimen.

For instance, if a piece of celluloid 1 in. wide and $\frac{3}{16}$ in. thick is placed in the plane *P* or the plane *Q*, when no stress is applied to it its image will be dark. If tension is applied by means of a screw, the image passes through a series of colors, first yellow, then red, then blue, again yellow, red, blue, etc., which series may be repeated four or five times. Thus there are first, second and third, etc., order colors, each color in the second and third order corresponding approximately to two and three times the stress for the same first-order color. The same series of colors is passed through for the case of compressions as for the case of tensions.

If bending instead of tension is applied to the specimen, the neutral axis appears as a dark line along the middle, with rainbow color-bands above and below this line corresponding to tension and compression, respectively, the second and third bands in each case representing two and three times the stress represented by the first band. For a more complex case of stress distribution, the color bands will be correspondingly more complex.

A few words must be said about stress in general

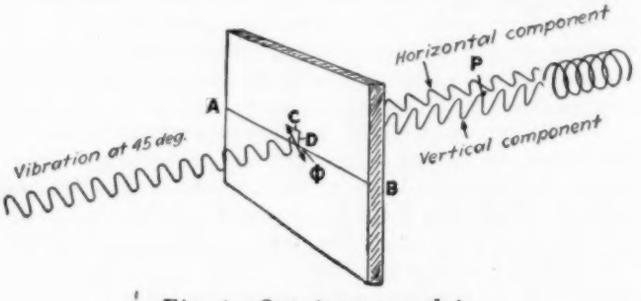


Fig. 4—Quarter-wave plate

before explaining how the color bands are analyzed to give the exact stresses. The stresses in any strained body follow along certain directions, called the principal-stress directions. Such a system of principal-stress direction is shown in Fig. 5 for the case of an elliptical hole in a celluloid plate about six inches wide and $\frac{1}{4}$ in. thick, to which tension has been applied in a direction perpendicular to the major axis of the ellipse. The stresses are characterized by the fact that they make right angles to each other at all points, and are everywhere parallel and perpendicular to the boundaries.

The amount of effect upon the circularly-polarized light at each point of the model is determined by the principal stresses *P* and *Q*, at each point. It has previously been shown how in the case of the quarter-wave plate, the incident light is separated into two components at right angles to each other, which are transmitted through the crystal with different velocities. So also the circularly-polarized light incident upon the stress specimen, Fig. 6, is resolved into two components, one parallel to the direction of the *P* lines and the other parallel to the direction of the *Q* lines, each component being transmitted with a velocity dependent upon the magnitude of the principal stress to which it is parallel. Evidently the light is not altered if the two principal stresses are of the same magnitude, because each component being transmitted with the same velocity emerges in the same phase as it entered,

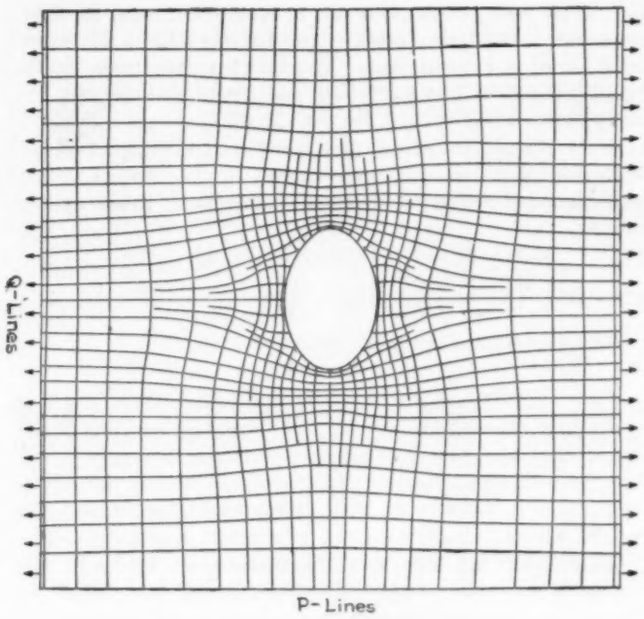


Fig. 5—Principal-stress lines

and they combine again to produce circularly-polarized light. If one principal stress is greater than the other, however, a difference in the velocity of transmission of the components is produced, which is proportional to the difference between the two principal stresses P and Q.

$$= C_1(P - Q)$$

where C_1 is a proportionality factor.

So also the color produced on the screen depends upon $P - Q$, in fact, the color bands give a direct measure of the principal stress difference, $P - Q$, at all points. Thus when the value of one of the principal stresses is zero, or is small compared with the other, the color bands give a direct measure of the stress at the point observed.

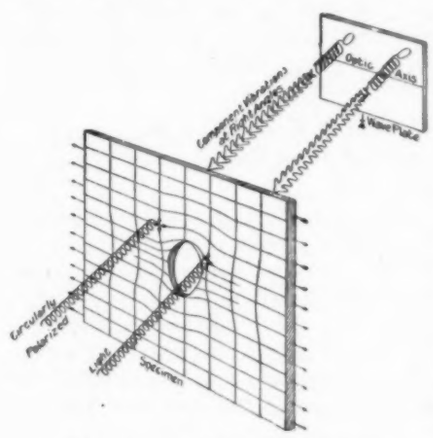


Fig. 6—Action of stress on polarized light

It will be recalled that principal-stress lines are always normal and tangent to the boundaries of a stressed body. Evidently the principal stress normal to the boundary must vanish at the boundary, since there is no material to support a normal tension or compression at a boundary. Therefore, the principal-stress difference, $P - Q$, upon which the color bands depend, becomes equal to the tangential stress at a boundary, so that at boundaries the amount of the stress can be directly determined from the color. Since in practically all cases the maximum stresses occur at boundaries, a simple color measurement will at once give the maximum stress. The simplicity and ease with which maximum stresses can be observed in the photoelastic model is thus apparent.

There are two ways of evaluating the observed colors in terms of stress. One is to construct a scale of color vs. stress, by applying a known tension to a sample of known cross section made from the same sheet of celluloid from which the model was made. The latter precaution is necessary since the optical properties of different sheets of celluloid may differ.

The other way to evaluate the stress is by a method of cancellation. A tension member, like that just described, to which a known load is applied, is placed crosswise to the direction of the stress to be measured in the second focal plane Q, Fig. 2. When the stress upon it is the same as the stress to be determined, the superimposed images give a black spot at the point under observation. The color effect is cancelled. The comparison tension-member is held in a special frame shown in Fig. 1, while in Fig. 7 it is shown greatly enlarged.

The color method is useful for rapid observation of maximum-stress points where the order of color is high. The cancellation method is the more accurate for ordinary cases, however. The method outlined give complete stress measurements for boundaries. The stress in a body is completely known when the magnitude of both principal stresses and their direction is known for every point in the body. For complete determination of stresses within boundaries, further observations are required besides a determination of the principal-stress system like that shown in Fig. 5. The observations are not difficult, but an explanation and description of them is beyond the scope of this paper.

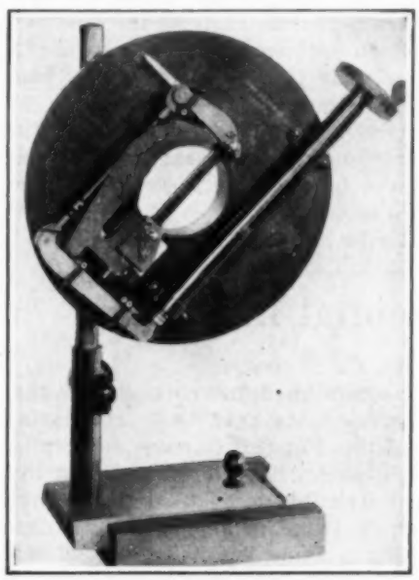


Fig. 7—Frame for comparison tension-member

When once the stress in the model has been determined, the translation of the results to steel is a simple matter. This is so, because in all true elastic bodies similarly loaded, the stress distributions are similar. Although the absolute value of the stress is far less in the celluloid than in the steel, the stress distribution is the same. The celluloid model will perhaps be loaded only $\frac{1}{100}$ as much as the steel. To find the stress in the steel member, multiply the stress at each corresponding point by 100. To take a simple case, a deflected beam of celluloid and a deflected beam of steel, similarly loaded, evidently have the same stress distributions, although the elastic modulus of steel is some 100 times higher than that of celluloid. Furthermore, the mathematical equations of stress distribution, where the stress directions lie in one plane, show that

for all ordinary cases the stress distribution is independent of the elastic modulus. Verification of the truth of the mathematical theory, within the limits of experimental error, has been obtained many times by the photoelastic method for celluloid for cases which are also subject to mathematical calculations. There is no more reason why celluloid should satisfy the mathematical requirement than steel.

In order that there be no misunderstanding, a word should be said about the limitations of this method. In using results obtained by the photoelastic method:

1—The results can be applied only to cases where the stress is below the elastic limit, so that Hooke's law that stress is proportional to strain is obeyed, and no plastic yielding has taken place.

2—The stresses obtained do not include possible initial stresses that may exist in the steel member.

3—The body is assumed isotropic. The crystalline structure must be small compared with the boundary irregularities.

These requirements are indeed none other than those of the usual engineering methods of the calculation of stress.

There is another fact that must be clearly grasped by those interested in the application of this method, and that is that the photoelastic method in its present state of development, will only analyze the stress distribution in one plane taken perpendicularly to the direction of the light rays. Such problems as torsion in shafts and stresses in helical-gear teeth are not readily handled by it. Many problems, however, can readily be treated as cases of stress in two dimensions, and for the solution of these problems, photoelasticity is a most effective tool and gives far more reliable results than any method hitherto obtained.

(To be concluded)

Differential Indexing

By W. Stainsby

IT FREQUENTLY occurs in engineering practice that gears or similar components have to be cut having a prime number of teeth. For this purpose differential indexing must be employed. It is not intended in this article to give any detailed account of differential indexing as this can be found in any of the standard works on machine shop practice, but it is intended only to develop a formula which will enable any operator to calculate the gears for any particular set-up.

Let N be the number of divisions to be cut (N is a prime number and the divisions cannot be cut by simple indexing). In each movement of the crank handle, the work must turn through a distance of $1/N$ of a revolution.

The first step is to select a number of divisions close to N which can be cut by simple indexers and to then calculate the gears necessary to give the correct value for N. The number selected may be either greater than or less than N, and each case will be considered in turn.

In Case I. Let A be a number of divisions close to N and let A be greater than N.

Let $A = N + X$, and $X = A - N$

R = Velocity Ratio of the gearing employed in differential indexing, which gearing may be either simple or compound, as determined by the exigencies of the case. In one movement of the crank handle, the work will rotate $1/N$ of a revolution, and in this movement, the index plate turns forward for a distance of R/N of a revolution. (The index plate travel must be increased a small amount as the divisions cut by simple indexing would be too small.)

With simple indexing, the work would rotate $1/A$ of a revolution for each movement of the crank. An equation may now be formed connecting these movements.

$$\frac{1}{A} + \frac{R}{N} = \frac{1}{N}, \qquad \frac{N + AR}{AN} = \frac{1}{N}$$

$$N + AR = A, \quad AR = A - N$$

$$\therefore R = \frac{A - N}{A}$$

since $X = A - N$, $R = X/A$

In the preceding proof, the assumption has been made that the ratio of gearing between the crank and the spindle was unity. In dividing heads, however, this ratio is usually 40 to 1 between the worm and the worm wheel.

Allowance for this fact must now be made in the formula and the corrected value for R will be $R = 40X/A = \frac{\text{gear on the spindle}}{\text{gear on the worm.}}$

An example will make its application clear:

Let N be the number of divisions to be cut, 71.

Let A be the number of divisions which could be cut by simple indexing, 72.

Then $X = A - N = 1$.

$$R = \frac{40X}{A} = \frac{40 \times 1}{72} = \frac{5}{9}.$$

Any gears, simple or compound, which give the ratio of 5/9 will be satisfactory. One point must be borne in mind and that is the direction of movement of the index plate. In this case, the index plate moves in the same direction as the crank, hence an idle gear must be interposed in the train of wheels connecting the spindle of the dividing head and the worm to ensure the correct rotation of the index plate. The idle gears selected will be the most convenient for the set-up, since its number of teeth will not affect the gear ratio.

In Case II, let B be a number of divisions close to N which could be cut by simple indexing and let B be less than N.

$$B = N - X, \quad X = N - B.$$

Using the same method as in Case I,

$$\frac{1}{B} - \frac{R}{N} = \frac{1}{N}$$

$$\frac{N - BR}{BN} = \frac{1}{N}$$

$$N - BR = B$$

$$R = \frac{N - B}{B} = \frac{X}{B}$$

Allowance must again be made for the ratio of the worm to the worm wheel, and so the corrected value of R becomes

$$R = \frac{40X}{B} = \frac{\text{gear on the spindle}}{\text{gear on the worm}}.$$

Care must be taken again to ensure that the index plate rotates in a direction opposite to the movement of the crank. Hence, no idle gears, or two idle gears may be interposed to give a correct movement. There is no advantage of either case over the other, though obviously the operator will select the case which calls for the gears he has in stock. Several ratios may be worked out and the most convenient one used.

Ball Bearings in the Making

By Ellsworth Sheldon
New England Editor, *American Machinist*

The third article—Assembling the bearings—Press work on the cages — Cleaning, testing and inspecting—Tests for noise and magnetism

HAVING followed in previous articles the various stages through which the balls and rings of ball bearings pass before they reach the stockroom, we will now consider the assembling of these parts into complete bearings.

An important difference between the early ball bearings of the so-called cup and cone type and the standard bearings in common use today lies in the fact that in the former there were used as many balls as the circular path of the races would accommodate, while in the latter a smaller proportionate number are assembled and the individual balls are held in definite relation to each other by a steel separator or cage.

The advantage claimed for the modern construction is that while in a bearing without a separator there will necessarily be friction between adjacent balls by reason of the surfaces in contact traveling in opposite directions, rubbing friction in a cage-type bearing can occur only between the balls and the relatively stationary cage. In the first case either the balls must slip upon each other or upon the races.

The Function of Separators

It is principally for this reason that the practice of introducing a separating wall between adjacent balls was adopted. Theoretically the balls should not touch the separators but should roll around the circular path always at the same relative distance apart. Actually they cannot be expected to do so for the reason that in no radial bearing are the balls always under uniform load.

The separators, one of which is shown in Fig. 1, consist of two main parts *A* and *B*, called the "cage-ends," and a number of stay-rods *C* equal to the number of balls in the bearing with which the cages are to be used. The cage-ends are blanked and formed progressively, being handled through the operations individually. The stay-rods are blanked from a strip in a continuously running press provided with a roll feed.

The tools shown in Fig. 2 are employed to set the requisite number of stay-rods in one cage-end, while the final assembly of the cage becomes a part of the bearing assembly as will be shown later. These tools, like all other press tools used in the assembling operations, are mounted upon a swinging bolster so that they may be swung out from under the press gate for unloading and reloading.

The operator sets the required number of stay-rods into radial slots properly disposed in the die, in which they are completely enclosed except for the projecting tenons at the upper end. The tenons at the lower end rest upon a cam-ring that may be turned by means of a small handle at the side of the die to eject the part after riveting. A cage-end is set over the tenons projecting from the die, the bolster swung under the gate and the press tripped, riveting all of the tenons at once.

The swinging bolster is so constructed that until it is in contact with its stop the press cannot be tripped. The operator must use her right hand to hold the bolster in position while with her left hand she depresses the clutch lever on the opposite side of the press. There is thus little likelihood of personal injury due to the premature movement of the gate.

The first operation in the actual assembly of the bearings, shown in Fig. 3, is gaging the outer rings and laying them out before the operator, each pile containing rings of a certain size. The gage shown

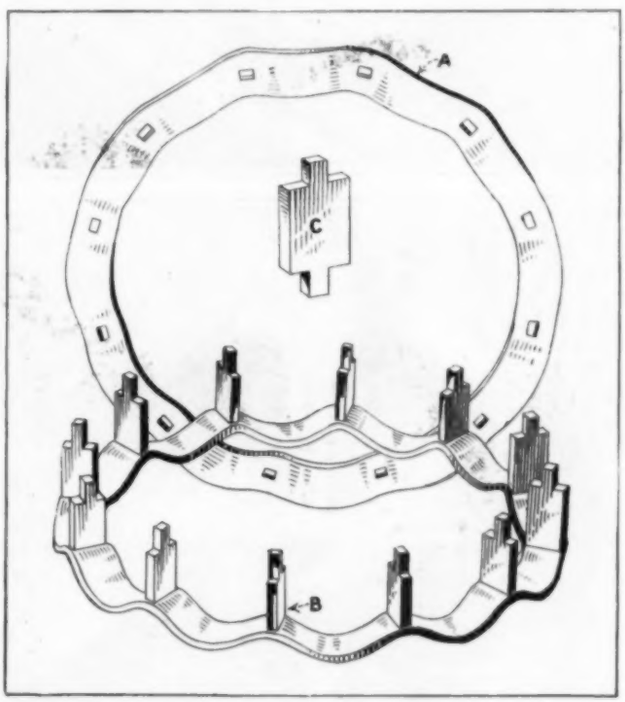
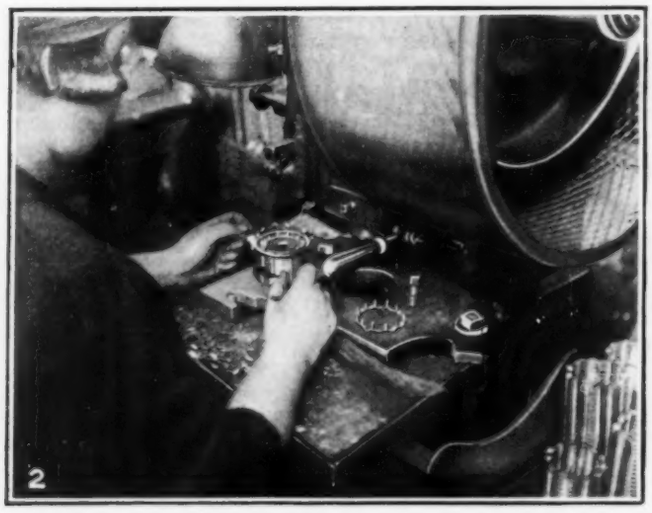
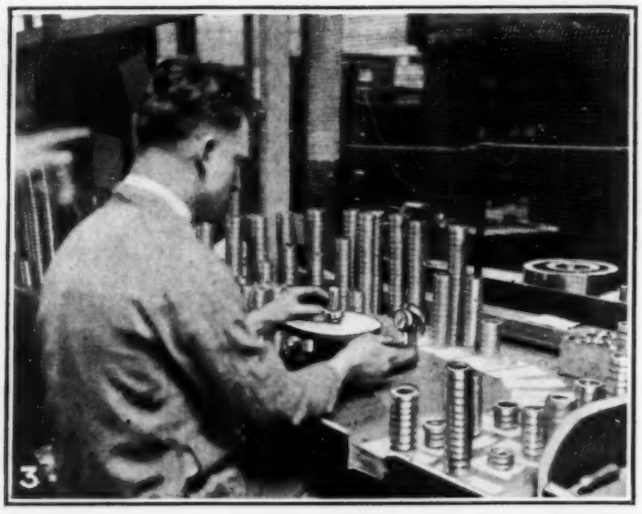
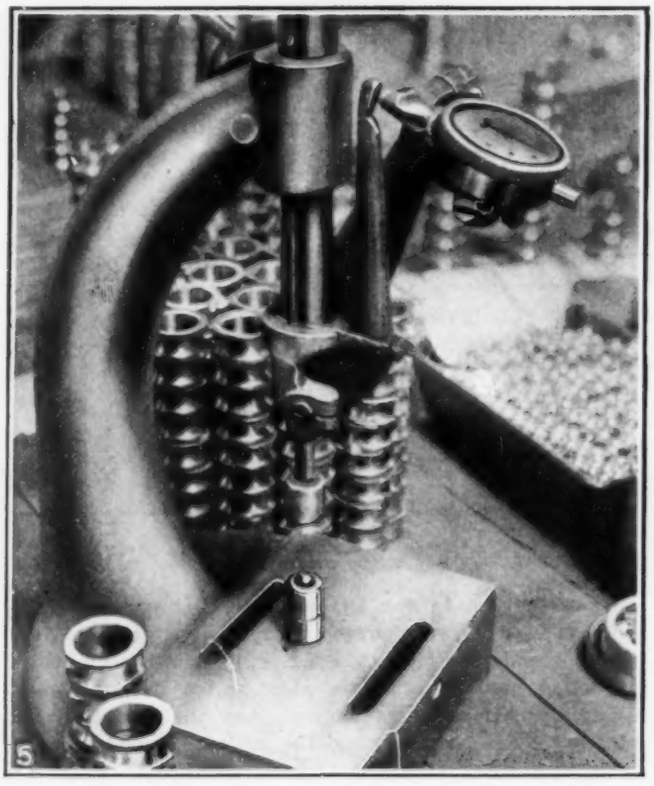


Fig. 1—Retaining cage for ball bearing

in Fig. 4 is used for the purpose. It consists of a tapered mandrel so mounted as to be capable of a slight vertical movement, a gaging ring containing three hardened balls of standard size, and a dial indicator. The gaging ring rests loosely upon the circular table of the device surrounding the mandrel and with the balls in contact with the tapered surface thereof, and the lower end of the mandrel itself is suitably attached to the end of a lever upon the opposite end of which the stem of the indicator bears.







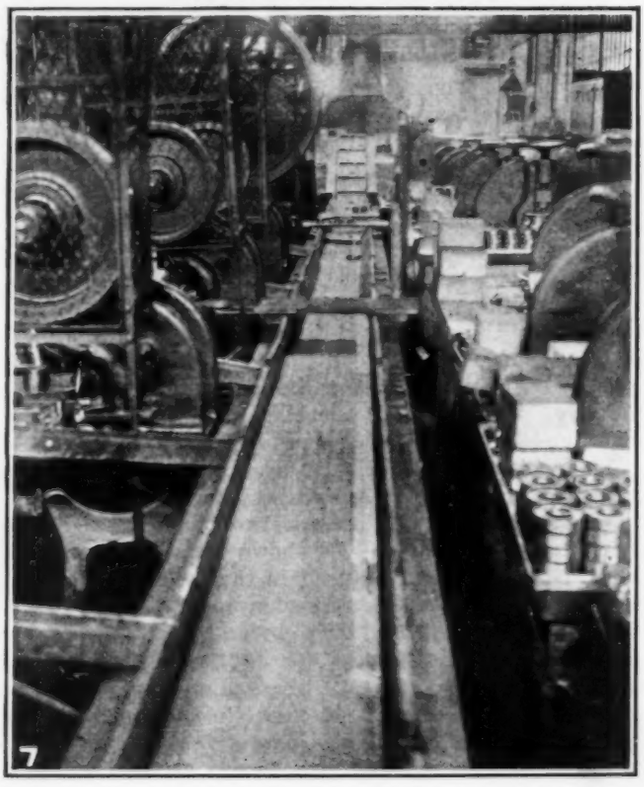


Fig. 2—First part of cage assembly. Fig. 3—Sorting the outer rings. Fig. 4—Gage to determine diameter of race. Fig. 5—Gage for inner rings. Fig. 6—First part of assemblying operation. Fig. 7—The conveyor back of the presses

The ring to be gaged is placed flat upon the table, surrounding the gaging ring, and the outer end of the lever at *A* is depressed by the operator. The vertical movement thus imparted to the mandrel causes the balls of the gaging ring to press outward into contact with the ball race of the ring to be gaged. The vertical position of the mandrel, and consequently the relative diameter of the ball race, is thus indicated on the dial. This combination of tapered mandrel and lever permits any desired amount of amplification, and variations as small as 0.00001-in. are easily differentiated.

Having sorted and arranged a quantity of outer rings, the gaging device, Fig. 5, is substituted and the assembler is ready to proceed. The operator in Fig. 6 picks up an inner ring from a box beside her, passes it under the gaging points and determines instantly from the reading of the indicator dial which one of the outer rings is its exact complement. She then lays the inner ring flat on the plate before her, places over it the proper outer ring and, holding them eccentrically, deposits a certain number of balls between them.

Giving the combined rings a quick shake—a movement acquired only by long practice—the balls are distributed around the raceway and the rings brought into concentricity. In this shape the bearings will withstand considerable handling without losing out any of the balls, provided they are not stood up edgewise. In the next operation the remaining number of balls required to fill the bearings are put in; after which the bearings may be handled at will, as they cannot then be disassembled except by deliberate intent.

The final operation is performed under a press and is analogous to that shown in Fig. 2 except that the stay-rods are already riveted in one of the cage-ends.

Fig. 8—Cleaning by compressed air

The operator places the part *B* (Fig. 1) in the bearing with the stay-rods between adjacent balls, inverts the bearing upon the die, sets over the projecting tenons the cage-end *A*, and strikes a blow with the press. This completes the assembly.

Behind the row of assembling presses runs the long belt conveyor shown in Fig. 7, at the end of which the washing and cleaning machine Fig. 8 is placed. The press operator drops a completed bearing into a chute conveniently placed beside the press, from whence it rolls on to the belt and is carried by it to the tanks of the washing machine. Here the bearings are thoroughly washed in filtered kerosene, rinsed in water,

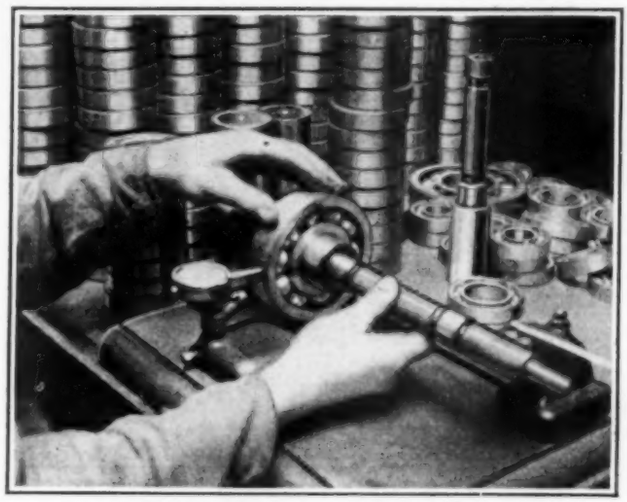


Fig. 9—The eccentricity test

dried and dipped in oil. The operator in Fig. 8 is "blowing" them with a jet of compressed air to remove possible particles of foreign matter and excess oil.

All bearings have to pass an eccentricity test, for which the device shown in Fig. 9 is used. The bearing is slipped on a true-running plug and the latter placed between centers. With the stem of the indicator bearing against the outer ring as shown in the illustration the outer ring is first held stationary while the plug with the inner ring is revolved; then the plug and inner ring is held stationary while the outer ring is revolved. In neither case should the pointer of the indicator show perceptible movement.

The indicator, which is held in a heavy base that is not attached to the table, is then moved around to the side and the movements repeated to see if there is any side motion, or "wobble."

In these days of motors, magnetic chucks and other electrical devices that are so commonly employed in manufacturing operations, residual magnetism is an evil that must be guarded against; especially in any product which, like a ball bearing, is composed almost entirely of hardened steel. Though all parts of the bearings are passed through demagnetizers at every stage of manufacture where magnetism can possibly be acquired, a further test is given them in this respect before they are ready for shipment.

In Fig. 10 at *A* is a coil of wire the ends of which are connected electrically with a reflecting galvanometer *B*, which is so arranged as to cause a beam of light to play over the scale when affected by a very minute current. The instrument is so adjusted that the beam at rest remains at zero in the center of the scale. Every bearing is passed into or through the coil, and should there be any magnetism remaining in any of the parts a current will be caused to flow in the wire of the coil and the beam of light will be moved one way or another by the movement of the magnetized part.

At *C* is a solenoid coil connected into the shop circuit and energized by the 110 volt, 60 cycle alternating current; constituting a demagnetizer. Though few of the bearings cause a deflection of the light beam, the few that do so are passed immediately through the solenoid and again tested.

Adjoining the assembling department is a room with double partitions and doors that make it as nearly sound proof as a room in a busy factory conveniently

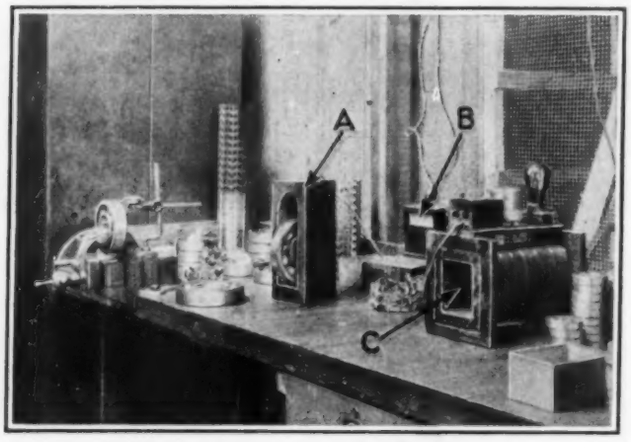


Fig. 10—Testing for residual magnetism

may be, and in this room all bearings are tested for noise. The only moving machinery in the room is a spindle that projects through the partitions; receiving its power from a point outside.

Each bearing is in turn slipped on this spindle and run at high speed for a few seconds to determine whether or not it makes too much noise. Of course no ball bearing can be expected to remain absolutely silent at high speeds, and this test depends solely upon the judgment of the operator. If he considers a bearing too noisy it is sent back to the shop to be inspected, disassembled and corrected or rejected as the case may require.

The Inspection Department—Discussion

By W. B. Wallace

There have been several discussion in the *American Machinist* regarding inspection and the functioning of inspection in its relation to manufacturing. These discussions have all been very good, but one of the main features of a successful inspection department has been omitted, and that is—the personality of the inspector.

It has been the writer's experience, in the study and actual working of inspection that this factor is one of the most important. It is very necessary that an inspector be familiar with the use of measuring tools, gages, proper interpretation of blueprints, etc., but even this required knowledge, if hindered by the lack of ability to reject the work of a machine operator in a way that will have the proper psychological effect upon him, will not only cause the inspector trouble in future contact with this man, but it will cause friction between the inspection and the production departments. If such a condition exists, the proper quality and economical fabrication of material cannot be maintained. Since quality and production are what we all must strive for, it would be well to give this matter more thought in employing and training inspectors.

Railroad Shop Problems

Effect of Oxyacetylene—Poor Castings and the Milling Problem

By Frank C. Hudson

Differences of opinion are not confined to those who attend horse races. The machine industry is full of them. And one is the effect of the oxyacetylene flame on steel when used for cutting.

Many are using it successfully while others wouldn't use a piece of metal cut in this way. The latter kind think it ruins the metal and that all sorts of calamities are likely to follow. That's what some of our railroad friends think about cutting side-rod forgings to a templet, rather than to mill off pounds and pounds of metal. Others, however, are using the torch-cutting method every day, saving a lot of money and having no more grief than the ones who decry its use.

It was reported that the highway commission of a western state had been tipped off that torch cutting was bad practice, and had forbidden it on structural steel to be used for a highway bridge. Hearing of this, the Union Carbide & Carbon research laboratories got busy and had E. E. Thum make a lot of experiments, testing each piece carefully after cutting and comparing them with a piece cut with a hacksaw.

The results showed that the flame-cut metal was a trifle stronger, due to the surface being slightly carbonized and hardened.

So we can apparently rest easy when it comes to cutting steel with a torch and continue to save time over the old method. The question of milling in railroad-shop work continues to attract attention. Side rods and crosshead guides are being machined regularly on milling machines in many shops. But the milling of brass seems to be a tough problem in many places. Some railroad shops are getting away with it on shoes and wedges, although most roads use cast iron for these parts. A few others are milling rod brasses but the shaper still holds forth in the majority of shops on this kind of work.

There has been a lot of experimenting by progressive railroad-shop men. The makers of milling cutters (for the cutter seems to be the real problem) have also taken a hand at the game. But while some progress seems to have been made, the problem is evidently far from licked as yet.

According to one cutter maker who has had a lot of successful experience in milling steel parts, one of the great troubles is the sort of castings used for rod brasses and other parts. Burnt sand and particles of other impurities seem to abound, especially in the corners and even the best milling cutter gives up part of the desire for cutting when it strikes burnt sand. As the maker says "We haven't yet learned how to make a cutter that will stand up very long when you feed it into an abrasive wheel."

This same question of dirty metal affects steel castings as well as those of brass, and is one that may deserve more attention than it receives. I have seen large and expensive planers tied up with a string of driving boxes on the table, while the operator was chipping out hard spots that had completely discouraged tools made from the best brand of high-speed steel that could be bought.

Indexing Mechanisms for Automatic Machinery

By C. S. Seltzer
Mechanical Engineer, American Can Company

The principle of the Geneva stop — Its development and application to indexing—Angular displacement and velocity curves — Mechanical design from a practical standpoint

INDEXING the work or tools is a problem met in the design of automatic machinery which presents certain features requiring careful thought. It is the intention of this article to describe principles devised for its solution.

Indexing involves starting a mass from rest and carrying it through a fixed distance, bringing it back to rest and accurately locating it, and no matter how small or great the mass, the pick-up and stop is in the nature of a shock.

It is necessary to reduce this shock as much as possible, and good results have been achieved by the use of the Geneva stop. The mechanism is composed of a driving and a driven element arranged so the driver rotating about its axis meets a pocket in the driven element and causes the latter to rotate until a roller at the end of the driver leaves the pocket. The driven element then remains stationary until the driver has rotated to a point where contact is made in the next pocket.

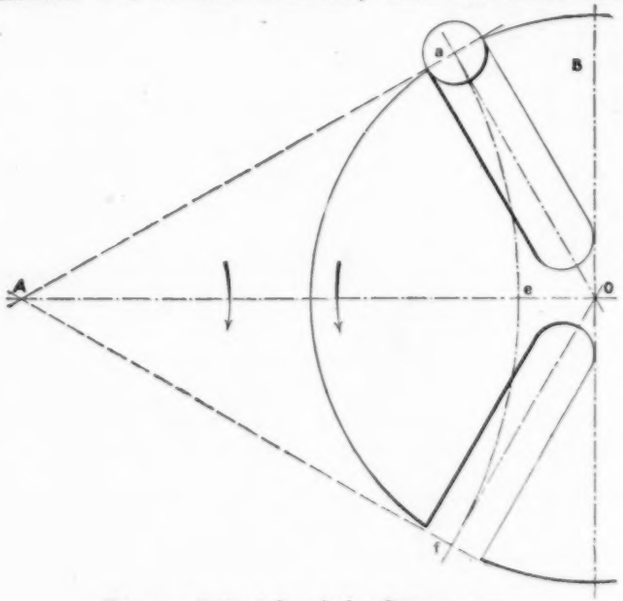


Fig. 1—Principle of the Geneva stop

In Fig. 1, the roller, shown entering a pocket at a, rotates about a center A at a constant speed in the direction indicated, passing through the point e to leave the pocket at f, and continues to rotate till point a is again reached. The pocket is moved during this time about its center of rotation, O, from the position shown by center line Oa to center line Of, where it comes to rest.

It will be seen in Fig. 2 that while the driving arm Aa is of a constant length, it moves in the pocket of the driven element B toward the center O as it rotates about its own center A. The power arm Oa will, therefore, decrease to Oe as its minimum length. At this point B is rotating at its maximum velocity. The start of motion in B is gradual as shown by the travel of Aa from a to b while B moves from a to b_1. Acceleration continues until e is reached, after which it proportionally decreases until it reaches f where conditions are the same as at the start.

Algebraically expressed, this acceleration becomes

$$\frac{V}{V_1} = \frac{ab}{ab_1} \text{ or } V_1 = \frac{V \times ab_1}{ab}$$

where V equals the velocity of driver and V_1 the velocity of the driven element.

In laying out the Geneva stop it is necessary to know the diameter as well as the number of pockets, then to proceed, draw a circle B with radius Oa, as shown in Fig. 3. Lay off angle α equal to $\frac{360^\circ}{N}$, where N equals the number of pockets. Bisect α with line OA. Through point a and tangent to B draw Aa, which will make angle $\frac{\beta}{2}$ with OA.

The length of the arm Aa, the center dimension C and the angle $\frac{\beta}{2}$ can be found as follows:

$$Aa = Oa \tan \frac{\alpha}{2}, \quad C = \sqrt{(Aa)^2 + (Oa)^2}, \quad \beta = 2\left(90^\circ - \frac{\alpha}{2}\right).$$

Assume 4 pockets in an 8-in. Geneva stop, as an example:

$$\alpha = \frac{360^\circ}{4} = 90^\circ, \quad \beta = 2\left(90^\circ - \frac{\alpha}{2}\right) = 90^\circ,$$

$$Aa = 4 \tan 45^\circ = 4, \quad C = \sqrt{4^2 + 4^2} = 5.656.$$

The velocity and angular travel of the driving arm Aa in relation to B is taken from Fig. 4 and plotted, as shown in Fig. 5. The points $a-b-c-d-e$, Fig. 4, are spaced equally distant along the arc aef and represent equal divisions of the movement of the driver. Lines drawn through these points and the center O intersect the edge of the Geneva circle at $a-b_1-c_1-d_1-e_1$ and show corresponding movements of a point on the driven element.

The points $a-b-c-d-e$ are laid off on the X axis in Fig. 5, while the other set are taken on the Y axis. The curve is then drawn through their intersections, that portion beyond the point e-e_1 being an exact reverse of the first portion as the driven element is

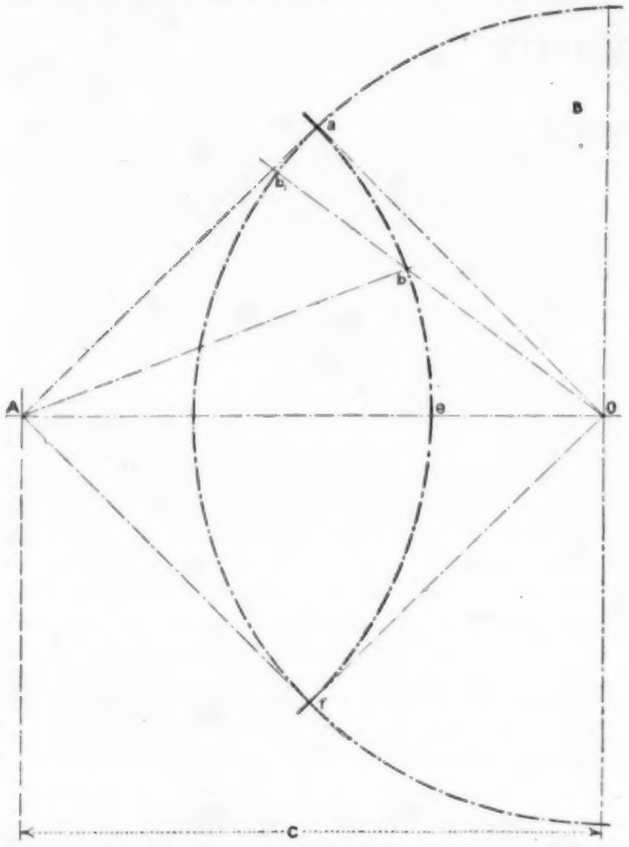


Fig. 2—Relation between driving and driven movements

brought from its maximum velocity again to rest. The degrees of rotation are marked on X and Y for use in checking the rotation of one part with relation to the other at any known distance which either has traveled. For example, where the driver has revolved 35 deg. the curve will show by the dotted line that the driven element has rotated approximately 23 degrees.

In the event that the exact distance of travel is required for the driven element for a corresponding travel of the driver, the mathematical equation for their relation may be used. It is developed as follows:

From trigonometry, and using Fig. 6 for reference:

$$\frac{h}{r \times \sin \alpha} = \frac{h}{(c-m)\tan\phi}$$

and $h(c-m)\tan\phi = h \times r \times \sin\alpha$,

or $r\sin\alpha = (c-m)\tan\phi$ (1)

The values for c and m are:

$$c = \frac{r}{\sin\frac{360^\circ}{2N}} \text{ and } m = r\cos\alpha = r\cos\left(90^\circ - \frac{360^\circ}{2N} - X\right)$$

Inserting these values in (1) we have:

$$r\sin\left(90^\circ - \frac{360^\circ}{2N} - X\right) =$$

$$\frac{r}{\sin\frac{360^\circ}{2N}} - r\cos\left(90^\circ - \frac{360^\circ}{2N} - X\right)\tan\left(\frac{360^\circ}{2N} - Y\right)$$

Simplifying, $\sin\left(90^\circ - \frac{360^\circ}{N} - X\right) =$

$$\frac{1}{\sin\frac{360^\circ}{2N}} - \cos\left(90^\circ - \frac{360^\circ}{2N} - X\right)\tan\left(\frac{360^\circ}{2N} - Y\right) \quad (2)$$

this being the equation that is to be used.

Assuming, then, that the driver has rotated 35 deg., that the number of pockets are 4 and that the diameter of the driven element is 8 in., or that X equals 35 deg., N equals 4 and D equals 8, substitution to find the value of Y may be made in equation (2) as follows:

$$\sin\left(90^\circ - \frac{360^\circ}{2\times 4} - 35^\circ\right) = \frac{1}{\sin\frac{360^\circ}{2\times 4}}$$

$$-\cos\left(90^\circ - \frac{360^\circ}{2\times 4} - 35^\circ\right)\tan\left(\frac{360^\circ}{2\times 4} - Y\right),$$

$$\sin 10^\circ = \left(\frac{1}{\frac{1}{2}\sqrt{2}} - \cos 10^\circ\right)\tan(45^\circ - Y),$$

$$\text{or} \quad \tan(45^\circ - Y) = \frac{0.1226}{1-0.695}$$

therefore $Y = 45^\circ - 21^\circ, 54' = 23^\circ$ and $6'$

This computation shows that the driven element rotates 23 deg. and 6 min. as compared to the 23 deg. taken approximately from the curve. It should be borne in mind that while this last curve and the preceding ones have all been plotted on an 8-in. Geneva diameter, they hold true for any diameter by reason of the geometrical construction of the movement.

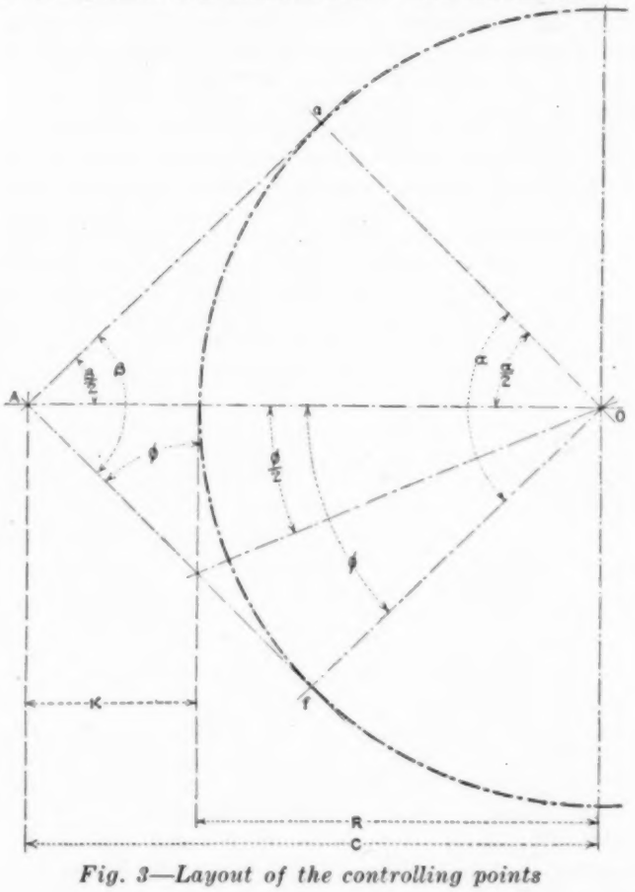


Fig. 3—Layout of the controlling points

To compare relative velocities of the elements of the Geneva in ft. per min., it is only necessary to multiply the initial velocity by the derivative of the angular relation just discussed. Referring to Fig. 7, in which the velocity curve is illustrated, the points on

this curve from the start to the point of greatest velocity for the driven element are the same as in Fig. 5, but the velocity of the driven element decreases beyond this point until it again reaches zero on a curve which is a duplicate so far as relative accelerations

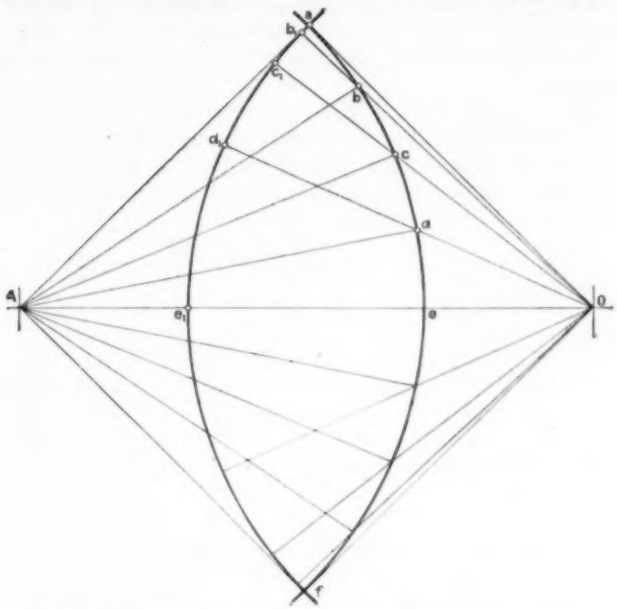


Fig. 4—Diagram to determine displacement curve

are concerned. The use of the curve in finding velocities can best be shown by taking a concrete example.

Assume that the velocity of the 4-pocket driven element is desired between 35 and 40 deg. on the X axis or driving-arm movement:

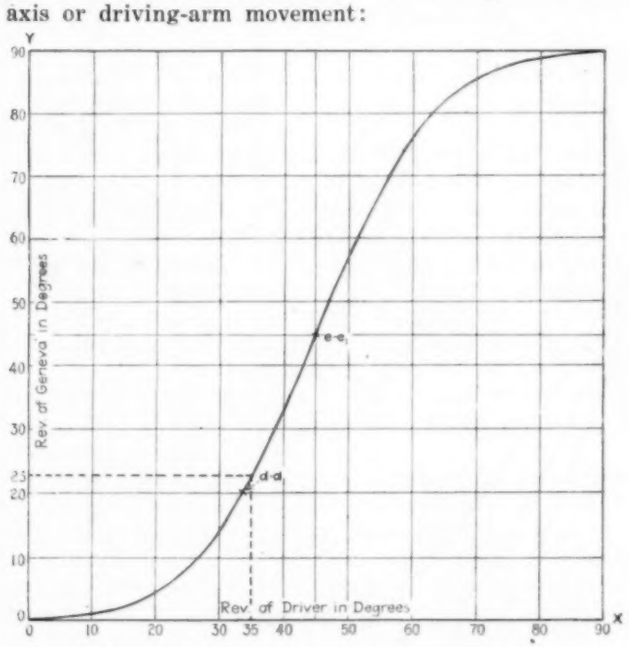


Fig. 5—The angular displacement curve

Draw the co-ordinate to intersect the curve as shown by the dotted line. A small triangle will then be formed whose opposite and adjacent sides, ΔY and ΔX, have values of (32° — 23°) or 9° and 5° respectively. Assuming further that the constant velocity of the driving arm is 200 ft. per min. the velocity of the Geneva while rotating between 23 and 35 deg. will be $\frac{9}{5} \times 200 = 360$ ft. per min. This figure also holds true for the same point on the curve which follows the decreasing velocity of the driven element beyond the point of maximum velocity, or between 50 deg. and 55 deg. of the driving-arm rotation.

This method of finding the velocities graphically is, of course, an approximation. The smaller the triangle that is used, the more accurate will be the resulting figure, but for different points on the curve different triangles must be constructed.

As in the case of relative rotation measured in degrees, the mathematical formula may be developed for its solution accurately. It is set down herewith and

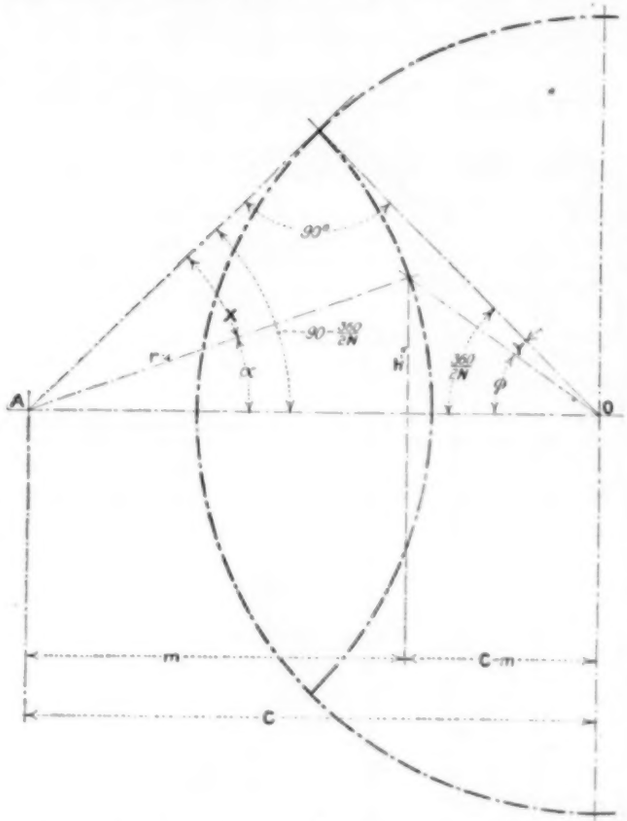


Fig. 6—Diagram for angular displacement formulas

assumed values substituted in order to show how accurately the curve may be used.

The derivative of equation (2) to satisfy the condition is:

$$\frac{dy}{dx} = -\frac{\left[\tan\left(\frac{360^\circ}{2N}-Y\right)\times\sin\left(90^\circ-\frac{360^\circ}{2N}-X\right)-\cos\left(90^\circ-\frac{360^\circ}{2N}-X\right)\right]\times\cos^2\left(\frac{360^\circ}{2N}-Y\right)}{\frac{1}{\sin\frac{360^\circ}{2N}}-\cos\left(90^\circ-\frac{360^\circ}{2N}-X\right)} \quad (3)$$

Assuming that $X = 35°$, $Y = 23°$, $N = 4$, and inserting these values in the formula, the following result is obtained:

$$\frac{dy}{dx} = -\frac{\tan(45^\circ-23^\circ)\times\sin[90^\circ-(45^\circ+35^\circ)]-\cos[90^\circ-(45^\circ+35^\circ)]\times\cos^2(45^\circ-23^\circ)}{\frac{1}{\sin 45^\circ}-\cos[90^\circ-(45^\circ+35^\circ)]}$$

$$\frac{dy}{dx} = 1.808$$

The final figure derived from the formula multiplied by the velocity of the arm will give the exact answer, or

$$200 \times 1.808 = 362 \text{ ft. per min.}$$

The curves for 3-, 4-, 6- and 8-pocket Geneva stops are plotted on one graph in Fig. 8 for convenient reference.

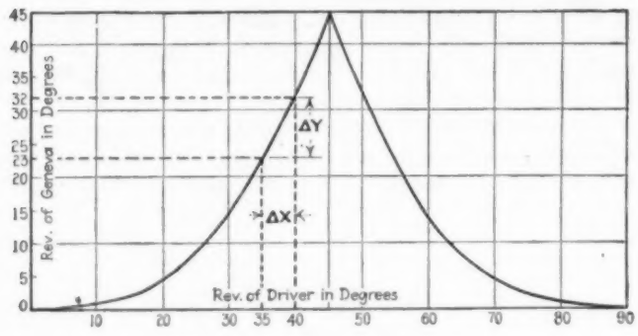


Fig. 7—The velocity curve

In determining the size of the Geneva stop and the number of pockets to be used, the following factors should be considered:

The proportion of driving-arm rotation.

The number of indexes to be made.

The driving-shaft clearance at the driven-element diameter.

The velocity of the mass to be indexed.

If the driving arm is to make one revolution to complete a cycle and $\frac{1}{4}$ of this revolution is available for indexing, for angle β in Fig. 3, and if it is desired to index for 6 work stations, then

$$\alpha + \beta = 180°, \quad \alpha = \frac{360°}{N} \text{ and } \beta = \frac{360°}{4} = 90°$$

substituting

$$N = \frac{360°}{180° - \beta} = \frac{360°}{180° - 90°} = 4$$

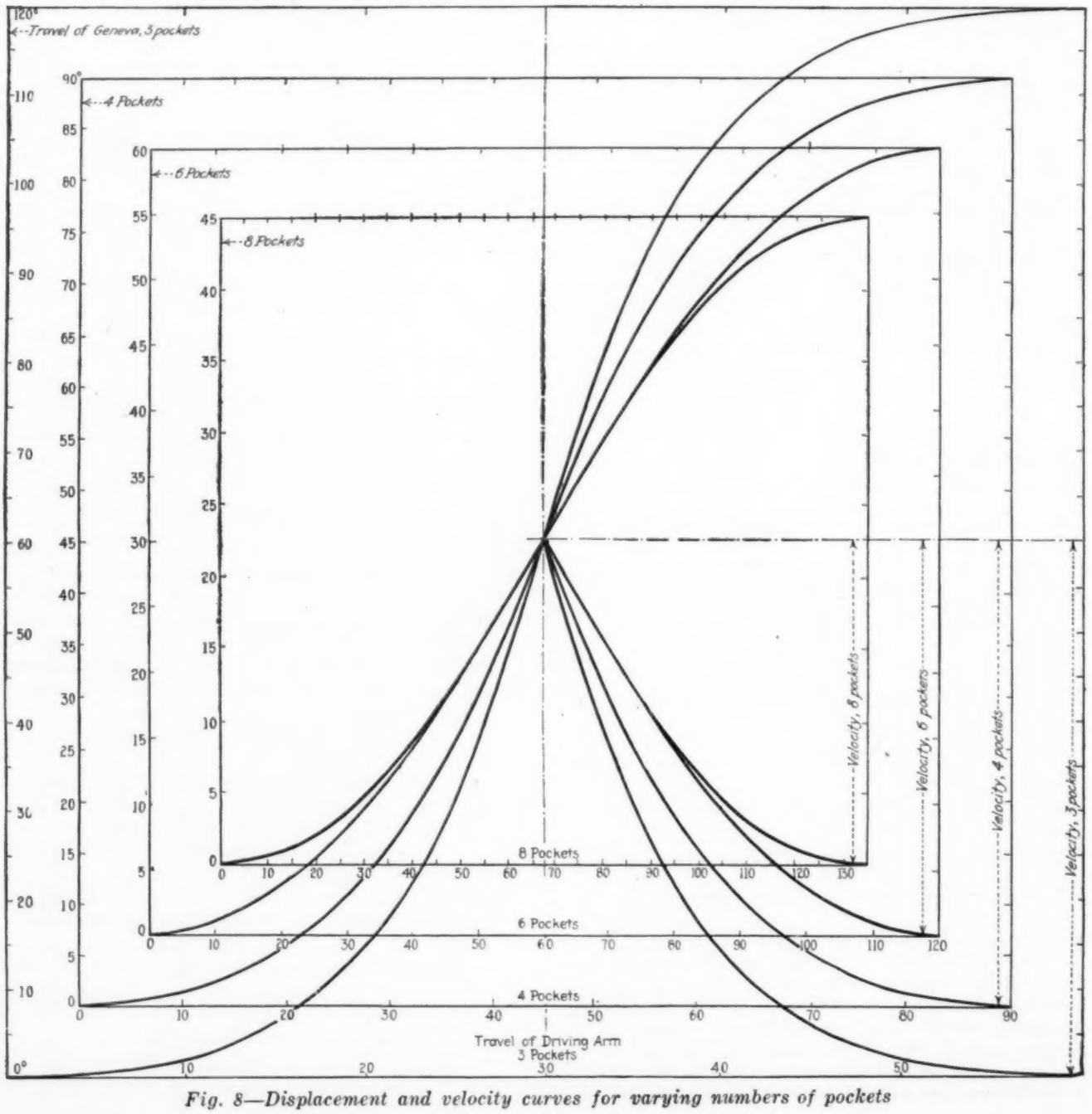


Fig. 8—Displacement and velocity curves for varying numbers of pockets

The Geneva will, therefore, index 4 pockets, as shown in Fig. 9, which makes it necessary to introduce a gear ratio of 4–6 between the Geneva gear and the member to be indexed.

The gearing is unnecessary, and it is possible to index direct, providing there is a sufficient portion of the work cycle available for the driving-arm travel.

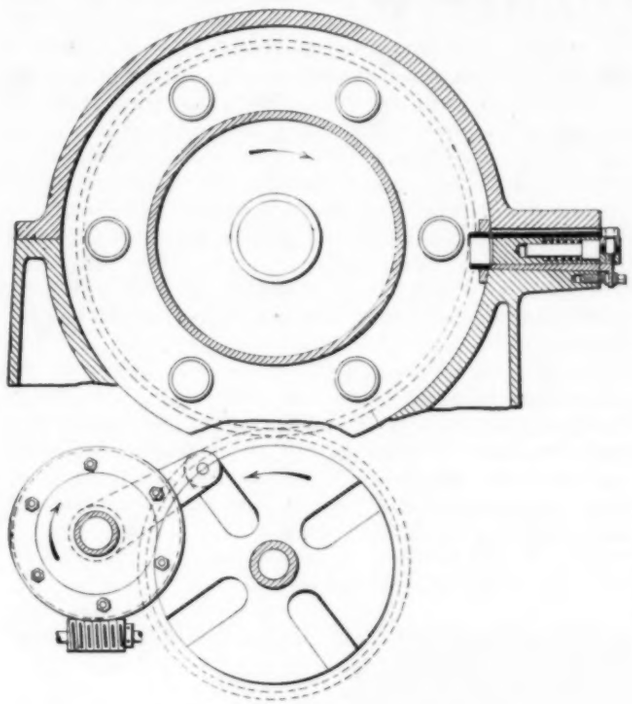


Fig. 9—A typical application

An insufficient portion of work cycle, however, may be compensated for, as shown in Fig. 10, by reversing the order of the gears.

Again, by introducing a third shaft which turns constantly and drives a clutch, Fig. 11, and by controlling this clutch with a trip that, at the proper time, causes it to engage and drive gear A and thereby actuate the driven element D through the gear B and the driving arm C, it is possible to use but $\frac{1}{4}$ of a revolution of the gear A and at the same time to index 6 stations. In this case the gear ratio from A to B is 3 to 2.

The condition shown here, however, is not so desirable for heavy work as is the arrangement shown in Fig. 9, as more intense strain will be set up in the driving element.

When the driving shaft is arranged to be supported in double bearings, as indicated in section A–A–A, Fig. 10, it is necessary to clear the outside diameter of the driven element with the shaft. Referring back to Fig. 3, this clearance K is equal to the dimension C, center to center of the two elements, minus R, the radius of the driven element. It is unlikely that the shaft will ever be less than 1 in. in diameter. Therefore, this radius, plus necessary clearance, will be approximately $\frac{5}{8}$ of an in. Since K varies as the number of pockets as well as the diameter, both diameter and number of pockets are functions of this dimension. But if we assume K as a minimum, we have it as a function of both of these items, and to find the minimum radius of the driven element, with K a certain quantity, and number of pockets variable, the equation to cover the condition may be written out. Referring to Fig. 3, we have

$$R = \frac{\left(\frac{K}{\tan \phi}\right)^2 \times \tan \phi}{K \times \tan \phi/2}$$

$$R = \frac{K}{\tan \phi \times \tan \phi/2}$$

Substituting known quantities,

$$N = 4, K = \tfrac{5}{8} \text{ in.}, \phi = \frac{180^\circ}{4} \text{ or } 45^\circ$$

$$R = \frac{\frac{5}{8}}{1 \times 0.414} = 1.5 \text{ inches}$$

Or if

$$N = 6, K = \tfrac{5}{8} \text{ in.}\ \phi = 30^\circ$$

then

$$R = \frac{\frac{5}{8}}{\tan 30^\circ \times \tan 15^\circ} = 4.04 \text{ inches}$$

The foregoing discussion may be summarized as follows:

To find the number of pockets, given the angular travel of the driver, such that N will be a whole number, $N = \frac{360^\circ}{180^\circ - \beta}$ where β is as shown in Fig. 3.

To find the number of pockets, given the angular travel of the driver that does not coincide with the required number of pockets, introduce reduction gears.

When the mass to be indexed exceeds 500 in.-lb., the outside diameter should be as near as possible to the outside diameter of the work.

When the mass to be indexed is less than 500 in.-lb.,

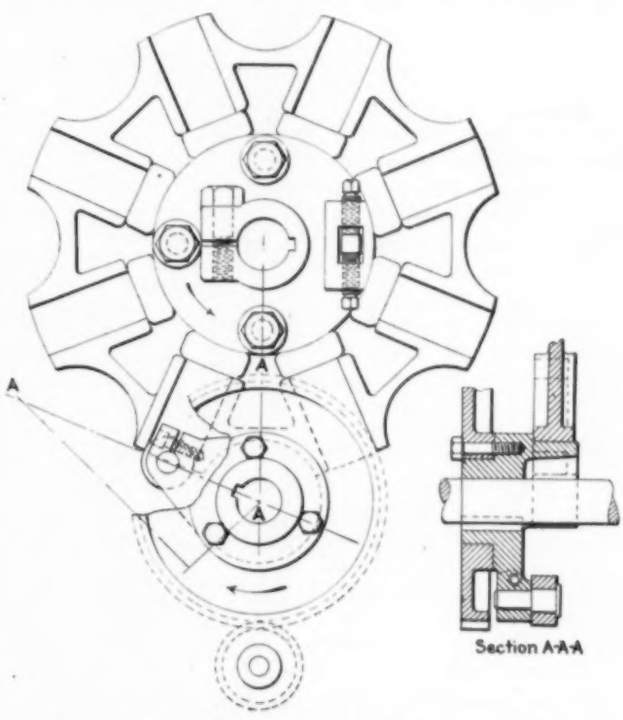


Fig. 10—Application to meet certain conditions

the outside diameter can suit the number of pockets.

When the driver shaft clears the outside diameter of the Geneva, the radius of the driven element equals

$$R = \frac{K}{\tan \phi \times \tan \phi/2}.$$

It will be noted that it is impossible to design a

Geneva with less than 3 pockets, for if $a = \frac{360}{N}$, with $N = 2$,

then $a = 180°$, which is an impossible condition

The high limit of N, however, can be made to suit

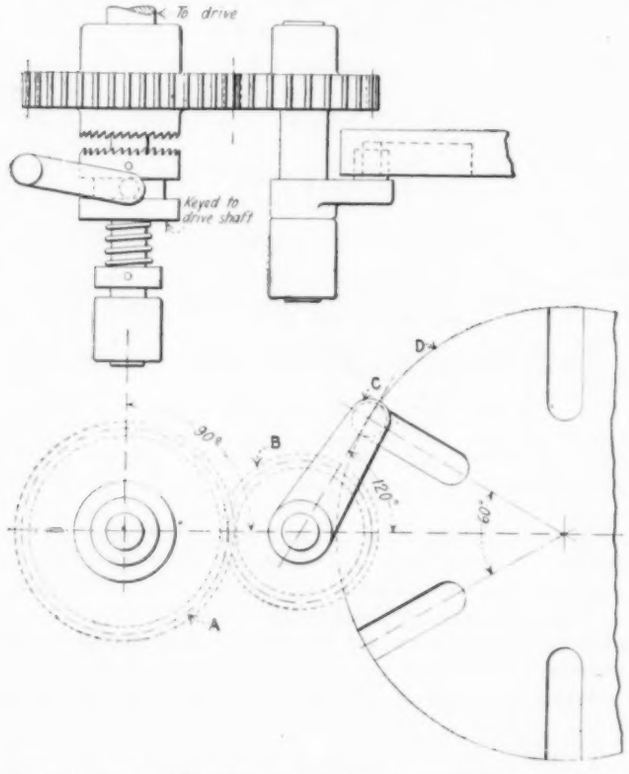


Fig. 11—Introduction of a clutch to control timing

the indexing conditions with certain practical restrictions controlled by the work to be indexed.

It may also be seen that when $N = 6$ or is greater than 6, $K = \frac{1}{2}$ but with $N<6$, K may be increased, namely, the diameter of the driven element can be made to suit conditions and K can act as a dependent variable.

Certain of the mechanical features of construction, as illustrated in Figs. 9 and 10, are worthy of note.

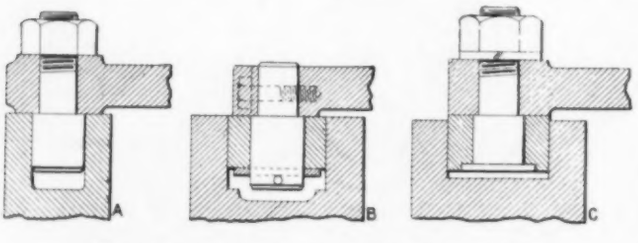


Fig. 12—Three designs of driver roller

Locks to prevent the driven element from any rotation while the driver is moving around to position with the next pocket are shown in both figures. The one illustrated in Fig. 9, however, is more desirable where great accuracy is required, for the machining can be held to closer limits with this arrangement and it has the added advantage of being more closely related to work which is supported on the spindle on the driven element. The upper edge of the lock is on center line with the work spindle while the lower side makes an angle that, if extended, will pass through the center of the spindle. This angle produces a wedge action on the turret when it is forced home by a lever which acts against the spring shown. This lever is cam actuated so that it is positively withdrawn at the instant that the driving arm is in position to move with the next pocket.

A means of aligning the pin in relation to the turret is provided with a hardened-steel plate and a gib. The pin picket is made as an insert in the work turret to provide against wear as well as to facilitate machining.

In Fig. 10 radii are cut between the pockets on the driven element that fit with a semi-circular raised portion on the driver. The two are so arranged in relation with each other that the lock goes into action just as the driving arm leaves a pocket and remains in this position until contact is made with the next pocket.

There is an adjustment shown by two screws in Fig. 10 which assists in attaining accurate alignment without the necessity of making an extremely accurate keyway fit.

In Fig. 12 are examples of various types of roll mountings followed in common practice. The arrangement shown at A is for light work only. That at B will take care of fairly heavy requirements, while the one at C is constructed to withstand unusual strain and can be depended on for any conditions that are liable to arise in daily practice.

What Is a 50-Ton Press?—Discussion

BY N. ANDERSON

I can sympathize with Mr. Kwizzer when he tells of his trouble to find out when a press is of 50-ton capacity and when it isn't. I have been there myself many a time but a still greater trouble comes to visit me when I try to find out what size press I need for my work—at least when the work is new.

Every time I have a new job of bending or forming or drawing I have a new conundrum and nobody to solve it for me. That is to say, that's how it used to be. A year ago I had a bright idea (by the way, once a year is about all I can figure on). I persuaded the manager to buy me a hydraulic press and ever since I have been able to solve my own problems. Every new job goes first to this press and I note the exact amount of pressure required to do a good job. If I am sure I have no press available and must buy a new one, I give the pressmaker the entire story, that is, not only the ultimate pressure, but a diagram showing the pressures all along the length of the stroke, as well as all other dimensions he needs. I let him make a selection and hold him strictly responsible. Of course, this does not prevent him from recommending a bigger press than I need but competition takes care of that point.

In order to find out if I have a press which will do the work, I compare the new job with one of which I have a record (gotten from my little hydraulic) and ask the maker of the press on which the old job is done whether he guarantees it for the new job as well. Even if he does, I try to satisfy myself by measuring the stretch of the press. I have a simple device for it: just a couple of rods and a test indicator. If I think this stretch is too much, I put it up to the press maker. A lot of trouble has already disappeared and I believe I'll have a cinch of it in a few years.

Shops of the L. & N. R. R. at Albany, Alabama

By Howard Campbell

Air-operated machines — Salvaging metal covering of car roofs — Preparing waste for packing journal boxes — Portable power saw—Machine for assembling air-brake hose

WHILE the Albany, Ala., shops of the Louisville & Nashville Railroad are quite old, advantage has been taken of every resource to enable repairs to the motive power to be made in the shortest time possible. Compressed air is utilized in many ways and a number of air-operated tools have been made. In addition, devices have been made to adapt standard tools to work foreign to their original purpose.

There is shown in Fig. 1, a drill press being used to turn and thread the brass plugs for grease cups. The tools for this work, to be seen in Fig. 2, consist of the box tool *A* and the threading tools *B*. The box tool has four high-speed cutters inserted as shown and held in place by setscrews. A bar having a slot in its lower end is placed in the spindle of the drill press, the slot engaging with a lug on the plug and serving to revolve the plug as it is fed into the box tool or the threading die, as the case may be. Cutting compound is used in the operation and the plugs are turned and threaded at the rate of 100 per hour.

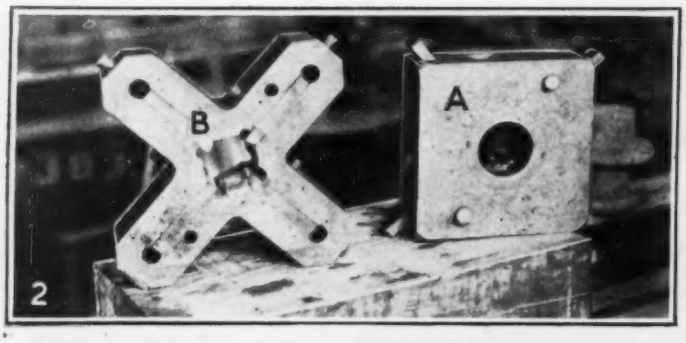
Liners for the shoe and wedge fits of driving boxes have been standardized. They are made of brass and provided with lips to fit over the tops and bottoms of the boxes. In addition to this precaution to keep them from getting out of place, the sides next to the boxes have six lugs, machined to fit six counterbored holes in the box. The liners are attached with rivets inserted from inner sides of the boxes and are headed over on the outsides by an air hammer. The tool shown in Fig. 3 is used for both drilling the rivet holes and hollow milling the projecting lugs. After being riveted in place, the liners are planed so the boxes will fit the space between the shoes and wedges.

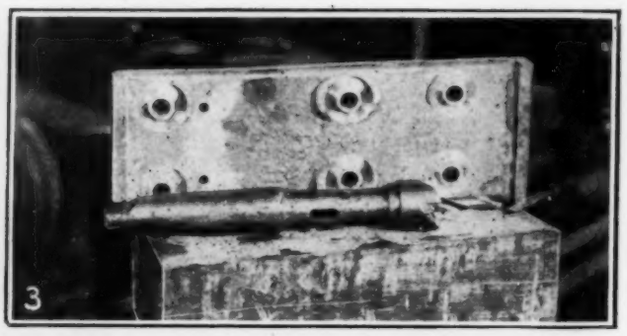
Fig. 1—Turning and threading grease-cup plugs

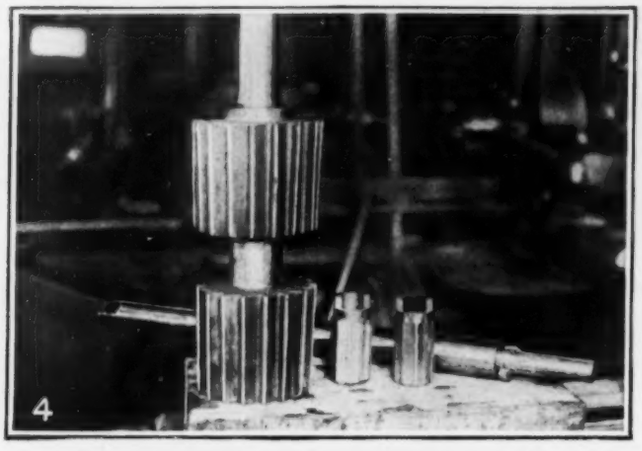
Among the special tools made in the shop toolroom, are the reamers shown in Fig. 4. The large reamer is for reaming a crosshead for the pin. In order to reduce the danger of breaking in hardening, the reamer is made in two sections, both of which are internally threaded and screwed on the arbor. The two small shell reamers standing beside the large one, are used in link-hanger work. They differ from the standard type of shell reamer only in the way they are fitted for driving. As will be seen, instead of a slot for the driving pin, one-half of the upper part of each is cut away to fit an arbor having a half collar machined from the solid. This method of driving eliminates the necessity of having the usual pins or keys in the arbor.

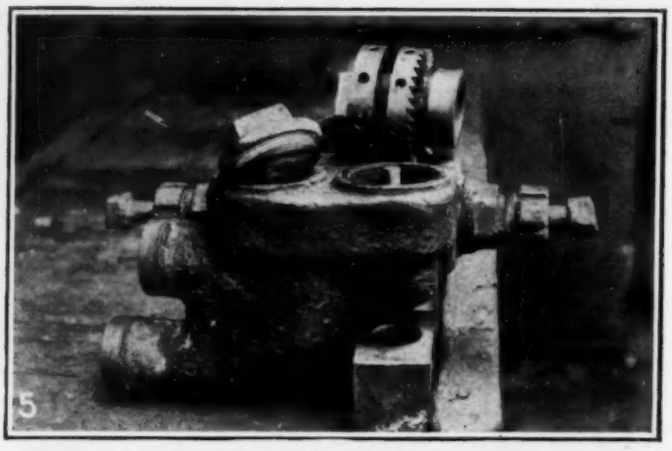
The tool shown on top of the boiler check in Fig. 5, is for refacing the seat for the cap of the valve. The cutter is a loose fit on the body so that it can be turned independently. In operation, the body is screwed into the valve until the cutter "bites" into the surface of the cap seat, when the cutter is turned by a spanner wrench, thus refacing the seat.

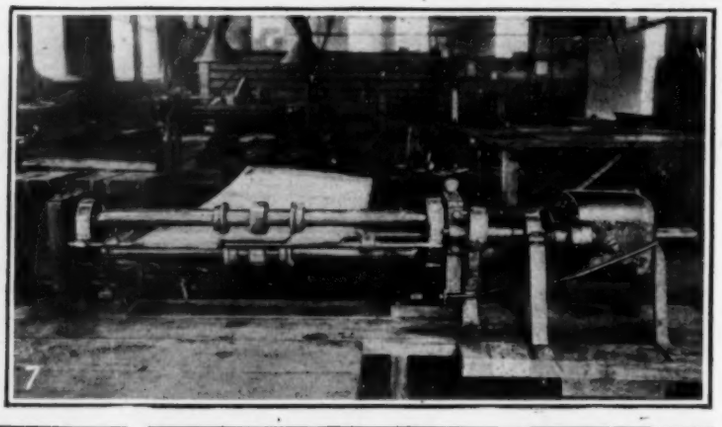
A convenient device for holding air pumps during repairs is illustrated in Fig. 6. The brackets to which the pump is attached can be swiveled through an arc of 180 deg. and clamped in any intermediate position. By this means the pump can be held in a position that will be most suited to the particular work that is being done upon it.











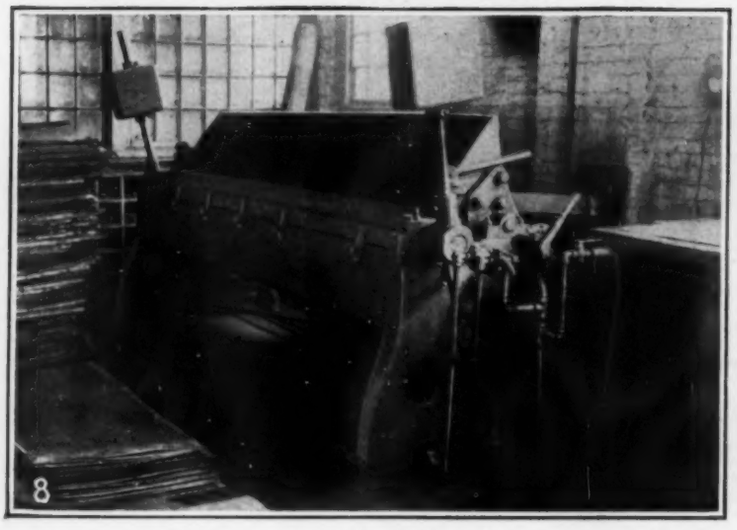
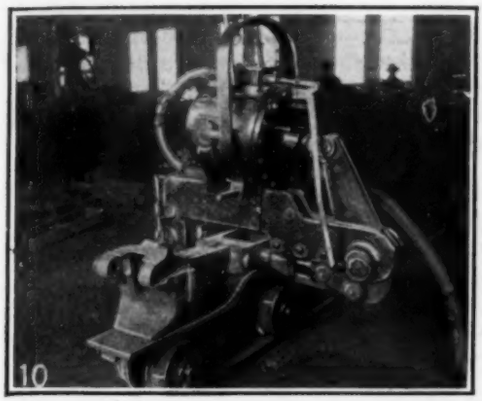


Fig. 2—Turning and threading tools. Fig. 3—Brass liner and hollow-milling tools. Fig. 4—Reamers for pins and link-hangers. Fig. 5—Boiler-check facing tool. Fig. 6—Air-cylinder stands. Fig. 7—Air-operated slitting machine. Fig. 8—Air-operated folding brake. Fig. 9—Trimming a car roof with a portable buzz-saw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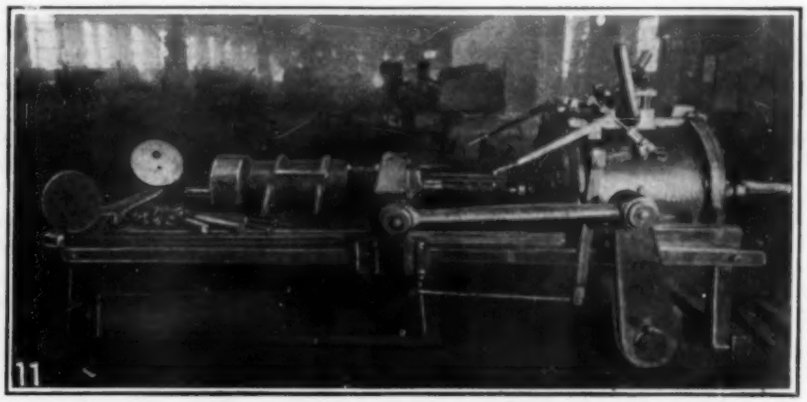
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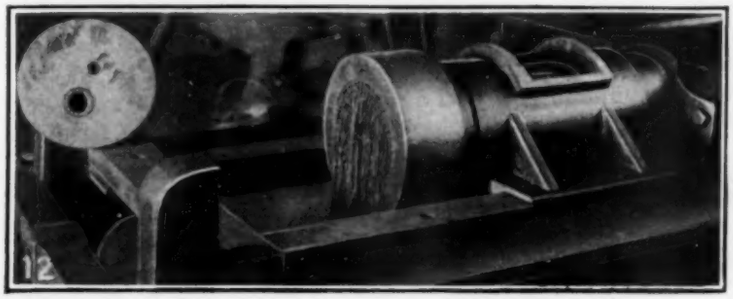
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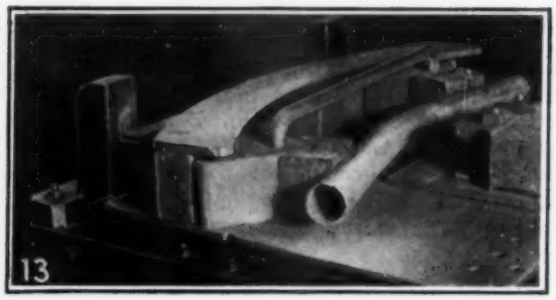
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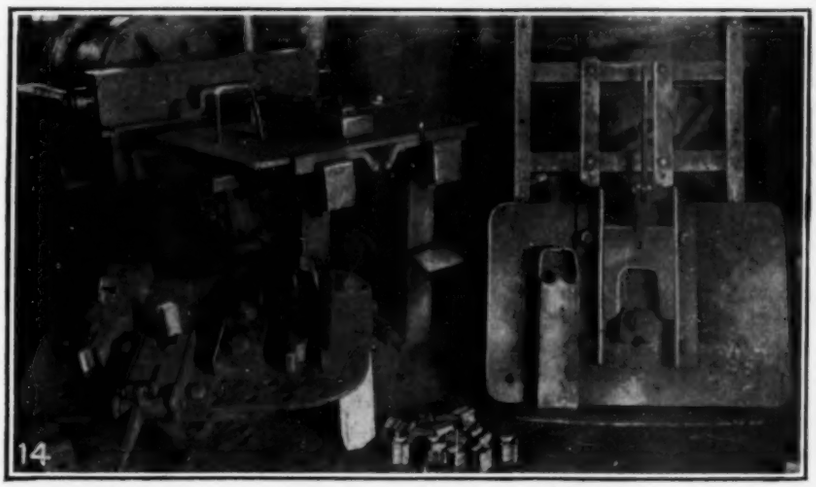
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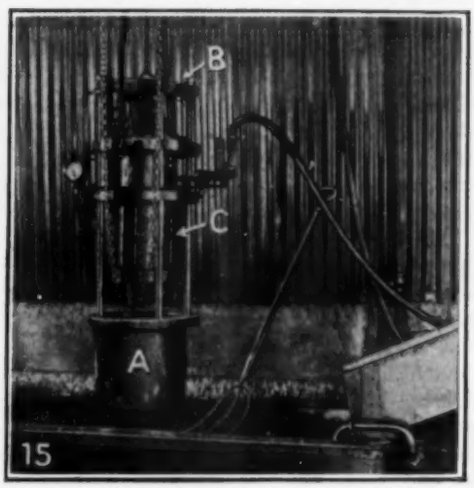

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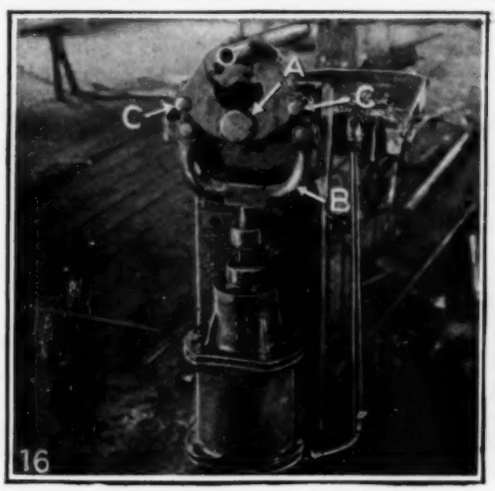

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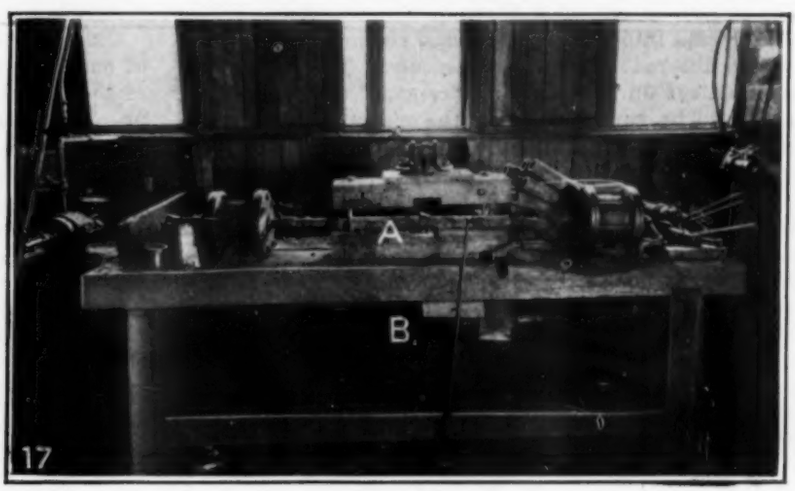

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Fig. 10—Air-operated riveting machine. Fig. 11—Air-operated press. Fig. 12—Reclaiming grease. Fig. 13—Pipe-bending attachment. Fig. 14—Dies for forming small parts. Fig. 15—Pressing oil out of waste. Fig. 16—Air-operated pipe vise. Fig. 17—Hose-mounting machine

When the metal covering is taken from the roof of a car undergoing repairs, the worn or rusted edges are trimmed off and it is cut up into sheets slightly smaller than the ones originally used. Any damaged sheets are, of course, discarded. The sheets are then reseamed and locked together. With the addition of enough new material to replace that trimmed off or discarded, a roof so salvaged will have a life of several years. The air-operated slitting machine shown in Fig. 7 is used in trimming and cutting up car roofs and for other work as well.

Another air-operated machine used on roofing material and other seamed work, is the folding brake shown in Fig. 8. At the left, can be seen a pile of salvaged roof covering awaiting an opportunity to be reworked. This machine is 9½ ft. long and can fold metal as heavy as No. 12 gage.

After a new roof has been put on a car, the edges or eaves are trimmed by the use of the portable, air-operated saw to be seen in Fig. 9. The two wheels upon which the device is mounted, are of different diameters to compensate for the angle of the car roof. The connection from the motor to the saw is made more or less flexible by means of universal joints. In operation, it is guided by one man, while his helper carries the motor and keeps pace with him in his travel along the roof. The saving over hand-sawing will pay for such a device in the trimming of a few roofs.

The equipment of the blacksmith shop comprises a number of home-made, air-operated machines for forging, riveting and bending. While the riveting machine illustrated in Fig. 10 is shown riveting a draw-head strap, it is used on a variety of other work. The cylinder is mounted on a heavy frame to which is attached a bail, so that it can readily be lifted and brought to the work by a crane.

The horizontal bending press in Fig. 11, also air operated, is used for bending a variety of work. As shown in the illustration it is fitted with a device for reclaiming the grease taken out of driving-box cellars, rod and compression cups. A closeup view of the device itself is shown in Fig. 12. Waste from the driving-box cellars is placed in the cylinder and pressed out through holes in the end plates as shown. In pressing out cup grease, the plate to be seen standing on the corner of the machine, in both views, is used. The grease is extruded through the two holes shown and formed into continuous round sections of two sizes to suit different sizes of grease cups. The long pieces are then cut up into sticks or "candles" of a convenient length. The bending end of the machine can be seen in Fig. 13, where it is equipped with dies for bending pipe to some particular shape.

A machine and tools for forming various sheet-metal articles are shown in Fig. 14. As pictured, the machine is set up for bending clamps for superheater pipes. The work is done partially in the machine and is completed in one of the hand-operated dies shown in the foreground.

Waste to be used for packing the journal boxes of cars, is thoroughly impregnated with lubricant by soaking it in a vat of car oil for 48 hr. at a temperature of 70 deg. F. and then pressing out the surplus oil. The oil-saturated waste is placed in the receptacle *A* of the device shown in Fig. 15. The receptacle is attached to the crosshead *B* by four rods, so that when air is admitted to the cylinder *C*, the receptacle is raised up to, and engages the lower end of, the cylinder which acts as a ram. The oil escapes through a series of holes in a plate at the bottom of the receptacle and falls into the tank beneath. The press is suspended from an overhead rail, so that it can be moved from over the oil tank to the waste bin. The bottom plate is hinged and latched to the receptacle, so that when it is unlatched and dropped, the waste is allowed to fall into the bin.

Enough oil is left in the waste so that when the latter is squeezed tightly in the hand, a slight amount of oil will ooze out. A pop valve is placed in the air connection to the cylinder of the device, so as to relieve the pressure at the proper point and also to prevent breakage of the parts from over-pressure.

In Fig. 16, an air-operated pipe vise may be seen. The air enters the bottom of the cylinder and forces the piston upward. The vise jaws are pivoted at *A* and are connected to the piston rod through the yoke *B* and the links *C*. As will readily be understood, upward motion of the piston causes the jaws to close and grip the pipe. The pipe will be securely held so long as pressure is maintained in the cylinder. Releasing the pressure allows the piston to fall, thus opening the jaws.

A machine for attaching connections to air-brake and steam hose is shown in Fig. 17. The hose is held in the vise or clamp *A*, the movable jaw of which is operated by suitable connections to the air cylinder *B*, under the bench at the rear. At the ends of the bench are air cylinders, the piston rods of which are equipped with fixtures to fit the connections to be pressed into the hose. The connections are coated with glue and entered into the ends of the hose by hand. When air is admitted to the cylinders, the pistons move inward and force the connections into place.

Hot Engine Oil More Dangerous than Gasoline

The recent tests at McCook Field, Dayton, Ohio, proved some very interesting things about fire in airplane crashes. It will be remembered that a number of obsolete planes were driven into a wall to see just where and how they would break up. They were run down an incline and up-ended just before striking the wall, so as to simulate the nose dive that usually accompanies a crash.

The observations were made with the aid of a number of moving picture cameras. By slowing down the speed of the films to get the slow motion, the actual breaking up of the planes could be easily studied. The wooden planes of the conventional type went to pieces like the "one-horse shay" of storied fame. The more modern planes, having frames constructed of steel, were hardly damaged in comparison.

The most valuable knowledge obtained, indicated that fire was not due to the gasoline carried, but to the lubricating oil in the engine. In many crashes, the oil under pressure from the engine was thrown against the red- or white-hot exhaust pipes and caught fire instantly. With this fire raging the gasoline, of course, took fire in a short time. But in no case did the gasoline take fire first.

To make sure of this fact the exhaust pipes were taken off of several planes and the exhaust allowed to shoot directly into the air. In no case did these planes take fire, although the gasoline poured over the ground from the ruptured tanks.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Plumb Bobs for the Machinist and Millwright—Discussion

By Chas. T. Plastow

In an article under the title given above, on page 172, Vol. 62, of the *American Machinist*, E. F. Creager describes a number of plumb bobs. I am sending you a sketch of a plumb bob I made some years ago, that I think has some decided advantages over the ones shown by Mr. Creager. Being square at the lower end, my plumb bob cannot roll when it is laid down, which is quite an advantage when one is working on a scaffold. The body is cast iron and has a steel point inserted in the lower end.

A plumb bob that will not roll

The cord retainer is so made that the cord can be removed without cutting off the knot. If so desired, the cord retainer could be made larger in diameter. The hole in the center of the bob could then be drilled down close to the lower end and filled with mercury, thus increasing the weight. A plug could then be inserted just below the cord retainer and would prevent the mercury from leaking out. This addition would make the bob much more accurate.

Application of Continued Fractions to Dividing-Head Problems

By W. Stainsby

Problems often arise in shop practice in which awkward and inconvenient fractions occur. The method described gives a convenient and easy way of finding, for the original fraction, a substitution capable of being made as closely approximate as desired and more directly applicable to the dividing head of milling machines. The method is based on the solution of the familiar continued fraction such as is shown:

$$\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{2}}}}}$$

This fraction may be regarded as being built up of a series of steps, five being used in this case, and by taking all of them in turn five values may be obtained. The result which will give the true value of the continued fraction is found by taking all of the steps, but each step or convergent, as it is called, will give an approximate value which will become more accurate as more convergents are used in the solution of the fraction as will be seen from the following illustration.

Convergent	Fractional Value	Decimal Value
$\cfrac{1}{1}$	1	1.0000
$\cfrac{1}{1+\cfrac{1}{2}}$	2/3	.6667
$\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{1}}}$	3/4	.750
$\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1}}}}$	5/7	.7143
$\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{2}}}}}$	13/18	.7222

It will be noticed that the errors alternate from positive to negative with each step, but that each error is less in numerical value than in the preceding, and therefore each successive convergent is a closer approximation to the real value of the fraction.

For a practical example of the application of the continued fraction let us take the following example:

Two holes are to be drilled on a milling machine at an angular distance apart of 25 degrees, 40 minutes, 25 seconds. Since the ratio of the worm to the worm wheel in a dividing head is 40 to 1, it follows that for one complete revolution of the worm, the worm wheel and the work will rotate 1/40 of 360 degrees or 9 degrees. Therefore for an angular distance of 25 degrees, 40 minutes, 25 seconds, we shall require two complete turns, giving 18 degrees, and also $\frac{\text{7 degrees, 40 minutes, 25 seconds}}{\text{9 degrees}}$ of a turn. We now

IDEAS FROM PRACTICAL MEN

wish to reduce this fraction to common terms, in this case, seconds, so we will have $\frac{27{,}625 \text{ sec.}}{32{,}400 \text{ sec.}} = \frac{1{,}105}{1{,}296}$.

The problem is now to reduce 1,105/1,296 to the form of a continued fraction. We do this by first proceeding as though we wanted to find the greatest common factor.

$$
\begin{array}{l}
1105)1296(1 \\
\quad 1105 \\
\quad \overline{191})1105(5 \\
\quad\quad 955 \\
\quad\quad \overline{150})191(1 \\
\quad\quad\quad 150 \\
\quad\quad\quad \overline{41})150(3 \\
\quad\quad\quad\quad 123 \\
\quad\quad\quad\quad \overline{27})41(1 \\
\quad\quad\quad\quad\quad 27 \\
\quad\quad\quad\quad\quad \overline{14})27(1 \\
\quad\quad\quad\quad\quad\quad 14 \\
\quad\quad\quad\quad\quad\quad \overline{13})14(1 \\
\quad\quad\quad\quad\quad\quad\quad 13 \\
\quad\quad\quad\quad\quad\quad\quad \overline{1})13(13 \\
\quad\quad\quad\quad\quad\quad\quad\quad 13 \\
\quad\quad\quad\quad\quad\quad\quad\quad =
\end{array}
$$

These quotients we arrange as the denominators of a continued fraction, whose numerator throughout is one.

$$
\begin{array}{ll}
1. & \\
2. & \\
3. & \dfrac{1}{1+\dfrac{1}{5+\dfrac{1}{1+\dfrac{1}{3+\dfrac{1}{1+\dfrac{1}{1+\dfrac{1}{1+\dfrac{1}{13}}}}}}}} \\
4. & \\
5. & \\
6. & \\
7. & \\
8. &
\end{array}
$$

The values of the successive convergents should then be arranged in tabular form.

Convergent	Fractional Value	Decimal Value
1.	1	1.0000
2.	5/6	.8333
3.	6/7	.8571
4.	23/27	.8519
5.	29/34	.8529
6.	52/61	.8524
7.	81/95	.8526
8.	1105/1296	.85262

With Brown & Sharpe dividing heads, there are three index plates with the holes as follows:

15, 16, 17, 18, 19, 20,
21, 23, 27, 29, 31, 33,
37, 39, 41, 47, 49.

Take the highest convergent whose denominator occurs on the index plates, which will be in this case 23/27 since 27 occurs on the index plate, and for the fraction 1105/1296 substitute this fraction.

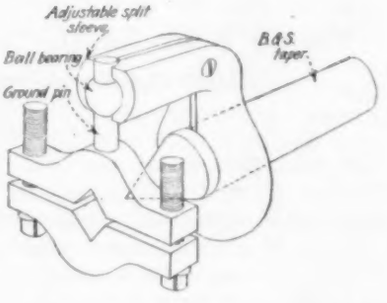
The complete solution of the problem is therefore two complete turns together with 23 holes on the 27-hole circle.

The error involved in this substitution is very small since 2.8519 has been used instead of 2.8526. This will cause the distance to be 0.02 per cent too small.

Eternal Vigilance the Price of Accuracy —Discussion

BY ALLAN B. SHAW

On page 402, Vol. 62, of the *American Machinist*, R. B. Willis, writing under the title given above, speaks of a helical fluting job on the milling machine "requiring more than the usual accuracy," on which a round tailed dog was used. Mr. Willis goes on to say that the job though correctly indexed came out wrong, due to the fact that the tail of the dog was slightly twisted, and therefore worked loose. The dog illustrated herewith (I have forgotten who the manufacturer is) is one of a type that I have used for over ten years in tool work, and in my opinion it is absolutely indispensable in fine work. If one of these dogs had been used on the helical job mentioned by Mr. Willis, there would have been no "working loose" and the trouble would not have existed.



A dog for indexing accurate work

Adding a Vertical Swivel to the Hoist Hook

BY W. EDWARD

A superintendent noticed the trouble his men were having in hooking a load to one of the cranes on account of the fact that it was difficult to swing the crane block back so the tip of the hook would incline downward. The hook swiveled readily in the block in the horizontal plane, but was rigid in the other direction. He remembered that the hooks and their connecting swivel links had been saved from some discarded chain hoists, and securing one of them he hung it on the crane hook, as illustrated. The clevis fitted nicely and the joints between it and the hooks made a very flexible arrangement.

A flexible hoist-hook

IDEAS FROM PRACTICAL MEN

Machining an Awkward Piece

By Chester H. Franklin

The pipe shown in the illustrations is about as awkward from the machining point of view as can be found in the average machine shop. The illustrations show two operations on the exhaust pipe for a large Diesel engine built by Fairbanks, Morse & Co. in their plant at Beloit, Wisconsin.

The first operation, Fig. 1, is milling the face of the flange that bolts to the cylinders and, as will be

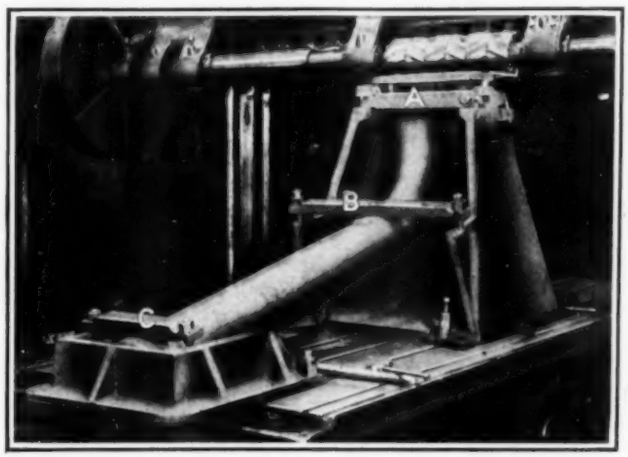


Fig. 1—Milling the flange on the end of exhaust pipe

seen, it requires a machine of considerable capacity to handle a comparatively small job, so far as the milling itself is concerned.

The method of holding the exhaust pipe is shown in the illustration, the flange being supported at each end at two points under each side. The two supporting screws shown in the front are carried in the swinging

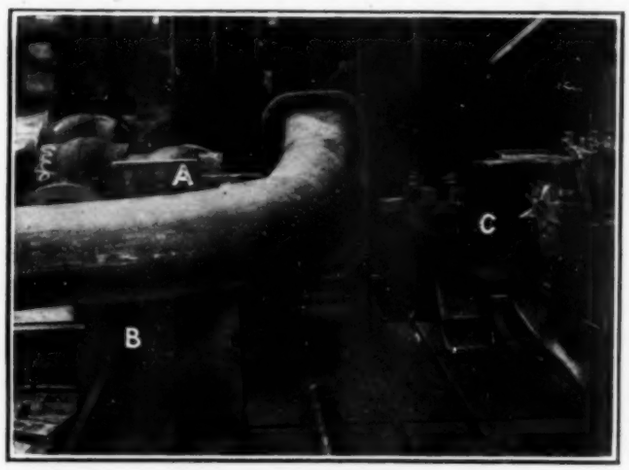


Fig. 2—Facing a side hole near the flange

arm *A* that also helps to hold the pipe against endwise movement. The clamp *B* holds the flange down against its support, while clamp *C* holds the lower end firmly in a suitable V-block held in the casting at the end of the planer table. Having the fixture in two separate pieces, not only economizes weight and makes it easier to handle, but also allows adjustment for any variation in the length of pipe that might occur.

Just below the flange there is a good sized opening on the far side of the pipe, and this opening is bored and faced on a floor boring machine. Fig. 2 shows how the flange is located against the angle plate *A*, on the bed of the boring machine. The weight of the pipe is carried on the other angle plate *B*. The facing of the metal around the opening is done by the facing head *C*, the feed being actuated by a star wheel such as generally used on facing heads.

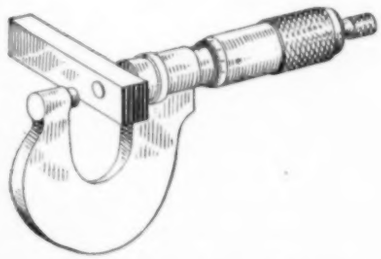
A third operation is turning the outside of the round end of the pipe shown beneath clamp *C* in Fig. 1. This turning is also done on a floor boring machine by the use of a sweep tool carried in a head on the end of the boring bar, the tool being set at the proper radius to give the desired diameter.

Repairing Micrometers—Discussion

By Ben West

I have read the article by H. J. Gustav Kopsch, under the title given above, and published on page 357, Vol. 62, of the *American Machinist*, but do not believe the method described by Mr. Kopsch would give accurate and satisfactory results.

By the method herein described, I have been able to get accurate results, even when the work has been done by a man whose skill is not of the highest. My method is as follows: I make a block about 1 in. wide, 2 in. long and ½ thick out of any material at hand, and put a hole in it to make a light wringing fit over the micrometer spindle. The block is placed over the spindle so that the worn end of the latter protrudes just enough to be trued after it has been lapped flush with the block. The sketch shows what I mean. Then the spindle is faced off by the use of a hone or lap.



Micrometer ready for lapping the spindle

The top and bottom of the block should be parallel, and the hole should be at a right angle to these surfaces. If the block is made of steel and hardened and ground all over, including the hole, so much the better. If the working face becomes worn, it can be trued up in the surface grinder, holding it on the magnetic chuck.

For lapping the anvil, I make a cast-iron lap about ¾ in. wide, 3 in. long and ¼ in. thick and charge one face with fine abrasive. The lap is placed between the anvil and the block on the spindle, and worked back and forth until the anvil is trued. The block on the spindle guides the lap so that the face of the anvil will be lapped parallel with the end of the spindle.

It is surprising how easily and quickly a badly worn micrometer can be put in good condition.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Portable Electric Drill Leads

Q. We use thirty portable electric drills in our hot-riveting department for reaming. It is necessary to have the lines to the drills on the floor and we are having a good deal of trouble in keeping them in working order on account of the kinking and also because of the hot rivets that burn through the insulation from time to time. Can you suggest a way to keep them longer in condition?

A. There are, on the market, a number of standard makes of electric cable designed especially for use with portable electric tools that are particularly well made to resist kinking. This cable can be obtained from most of the larger dealers in shop equipment as well as the makers of your electric drills.

Another way that we have seen working to advantage is to run ordinary wiring through old air hose which is fitted with side outlets at each end for the wire to come through and with a special nipple to screw into the drill and a standard air hose connection at the other end which can be connected to a blind air-fitting, anchored near your point of plugging in for the current.

This old hose, of which you doubtless have a good deal, resists twisting on the part of the operator the same as the hoses on the air hammers do. The hose itself will afford protection from the hot rivets and the method described for connecting it will keep all strain off the wiring.

Tightening Press Tie Rods

Q. There are four tie rods on a press we have purchased and we expect to shrink them in. Can we heat them and pull the nuts down all possible or is there a chance of thereby exerting too great a strain on them?

A. It is not only possible but quite probable that you will strain the material beyond its safe limit should you shrink the rods as far as you are mechanically able with a torch and wrench. The stress may even be beyond the safe margin in the initial set up without having any balance to take the applied load when the press is in operation.

If you will send us the size data of your new equipment we can give you definite figures. In the meantime here is an example of what can happen on shrinking:

Assume the rods 100 in. long.

From Kent the coefficient of expansion of steel is roughly 0.0000067 in. per in., per deg. of temperature rise.

Assume you heat to an average increase of 500 deg., and pull the nuts only snug, then, $p = \frac{\Delta E}{1} = \frac{(0.0000067 \times 100 \times 500)30{,}000{,}000}{100} = 100{,}500$ lb. per sq.in.

This is obviously very much too high. In fact when the load is applied the rods should not be stressed more than an amount which will allow a factor of safety of four or 15,000 lb. per sq.in. The elongation allowable, to set up an initial stress in the rods, should be carefully calculated with the work load taken into consideration, so the final stress does not exceed this figure. The nuts should be set snug before the rods are heated and then turned only the correct amount after the heat has been applied and rods have lengthened out.

Automobile Starter-Ring Design

Q. How are starter rings held on automobile engine flywheels? Please also tell us if there is a standard gear tooth for these rings.

A. It is customary to stamp the rings with the size to which the flywheel is to be turned with a usual allowance of approximately 0.030 in. or an equivalent of 0.002 in. per in. of diameter for a shrink fit.

We are informed that a great majority of gears are an 8/10 stub tooth with a few cases where 7/9 and 10/12 have been adopted.

Clearing Chips from Jig-Drilled Work

Q. We have difficulty in clearing chips from certain of our jig-drilled parts. The chips clog under the bushings and tend to cause the drills to clog and burn. In some cases bushings that were tight in the jig are worked loose and rise from their holes as the drilling proceeds. Can you suggest a remedy?

A. The trouble experienced is due to there not being sufficient clearance for the chips between the end of the bushing and the work. If the bottom of the bushing cannot be set tight against the work so there will be no space for the chips to wedge in, then the distance from the surface of the work to the bottom of the bushing should not be less than 1¼ times the diameter of the drill. Otherwise the bushing should be a slip fit and allowed to rise after the drill is centered and the chips begin to gather.

Making a Taper Press-Fit

Q. In making a taper press-fit of a disk on the end of a shaft we machined the parts properly, used white lead to prevent the surfaces from cutting and tried to press the disk home in our forcing press. The gage registered so high with the disk yet to reach the shoulder that we were afraid to go any further. We finally had to wipe off all the white lead and make the fit dry, taking a chance on cutting. Can you tell us the proper lubricant to use in the future.

A. A taper press-fit should be made dry. There is not sufficient relative motion between the parts after they come in contact to cause cutting and there is no wiping action such as in a straight fit to move the film of lubricant. The result is that the press allowance is increased by the thickness of this film and the parts will not go together.

Cutting Speed Conversion Table

Surface Feet to R.P.M.

Diam. in Inches	FEET PER MINUTE														
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
	REVOLUTIONS PER MINUTE														
1/16	917	1223	1528	1834	2140	2445	2751	3057	3363	3668	3974	4280	4586	4891	5197
1/8	459	611	764	917	1070	1222	1375	1528	1681	1834	1986	2139	2292	2445	2598
3/16	306	408	509	611	713	815	917	1019	1121	1222	1325	1426	1529	1630	1732
1/4	229	306	382	458	535	611	688	764	851	917	994	1070	1147	1122	1300
5/16	183	245	306	367	428	489	550	611	672	733	794	856	917	978	1039
3/8	153	204	255	306	357	408	458	509	560	611	662	713	764	815	865
7/16	131	175	218	262	306	349	393	437	481	524	568	611	656	699	743
1/2	115	153	191	229	268	306	344	382	420	459	497	535	573	611	649
9/16	102	136	170	204	238	272	306	340	373	407	441	475	509	543	577
5/8	91.8	123	153	184	214	245	276	306	337	367	398	428	459	489	520
11/16	83.3	111	138	167	194	222	249	273	300	333	360	389	416	444	472
3/4	76.3	102	127	153	178	203	229	254	279	306	330	357	381	408	432
13/16	71.1	94.8	119	142	166	190	213	237	261	284	308	332	356	379	403
7/8	65.5	87.3	109	131	153	175	196	219	241	262	285	306	329	349	372
15/16	61.0	81.4	101	122	142	163	183	204	224	244	265	285	305	326	346
1	57.3	76.4	95.5	115	134	153	172	191	210	229	258	267	287	306	325
1 1/16	53.9	71.8	89.8	108	126	144	162	180	197	215	233	251	269	287	305
1 1/8	51.0	68.0	85.0	102	119	136	153	170	187	204	221	238	255	272	289
1 3/16	48.3	64.4	80.5	96.6	113	129	145	161	177	193	209	225	242	258	274
1 1/4	45.8	61.2	76.3	91.8	107	123	137	153	168	183	199	214	230	245	260
1 5/16	43.6	58.2	72.8	87.3	102	116	131	146	160	175	189	204	218	233	247
1 3/8	41.7	55.6	69.5	83.3	97.2	111	125	139	153	167	180	195	208	222	236
1 7/16	39.8	53.0	66.3	79.5	92.8	106	119	133	146	159	172	186	199	212	225
1 1/2	38.2	50.8	63.7	76.3	89.2	102	115	127	140	153	165	178	191	204	216
1 9/16	36.6	48.8	61.0	73.2	85.4	97.6	110	122	134	146	159	171	183	195	207
1 5/8	35.0	47.0	58.8	70.5	82.2	93.9	106	117	129	141	152	165	176	188	199
1 11/16	33.9	45.2	56.5	67.8	79.1	90.4	102	113	124	136	147	158	170	181	192
1 3/4	32.7	43.6	54.5	65.5	76.4	87.3	98.2	109	120	131	142	153	164	175	185
1 13/16	31.7	42.2	52.8	63.3	73.9	84.4	95.0	106	116	127	137	148	158	169	179
1 7/8	30.6	40.7	50.9	61.1	71.3	81.5	91.9	102	112	122	133	143	153	163	173
1 15/16	29.6	39.4	49.3	59.1	69.0	78.8	88.7	98.5	108	118	128	138	148	158	167
2	28.7	38.2	47.8	57.3	66.9	76.4	86.0	95.5	105	115	124	134	143	153	162
2 1/8	27.0	36.0	45.0	54.0	63.0	72.0	81.0	90.0	99.0	108	117	126	135	144	153
2 1/4	25.4	34.0	42.4	51.0	59.4	68.0	76.2	85.5	93.5	102	111	119	128	136	145
2 3/8	24.2	32.2	40.3	48.3	56.4	64.4	72.5	80.5	88.6	96.6	105	113	121	129	137
2 1/2	22.9	30.6	38.2	45.8	53.5	61.2	68.8	76.3	84.2	91.7	99.5	107	114	122	130
2 5/8	21.8	29.0	36.3	43.5	50.8	58.0	65.3	72.5	79.8	87.0	94.3	102	109	116	123
2 3/4	20.8	27.8	34.7	41.7	48.6	55.6	62.5	69.5	76.5	83.4	90.4	97.2	104	111	118
2 7/8	19.8	26.4	33.0	39.6	46.2	52.8	59.4	66.0	72.6	79.2	85.8	92.4	99.0	106	112
3	19.1	25.5	31.8	38.2	44.6	51.0	57.3	63.7	69.9	76.4	82.6	89.1	95.3	102	108
3 1/8	18.3	24.4	30.5	36.6	42.7	48.8	54.9	61.0	67.1	73.2	79.3	85.4	91.5	97.6	104
3 1/4	17.6	23.4	29.3	35.1	41.0	46.8	52.7	58.5	64.4	70.2	76.1	81.9	87.8	93.6	99.5
3 3/8	17.0	22.6	28.3	33.9	39.6	45.2	50.9	56.5	62.2	67.8	73.5	79.1	84.8	90.4	96.1
3 1/2	16.4	21.8	27.3	32.7	38.2	43.6	49.1	54.5	60.0	65.5	70.8	76.4	81.8	87.4	92.7
3 5/8	15.8	21.0	26.3	31.5	36.8	42.0	47.3	52.5	57.8	63.0	68.3	73.5	78.8	84.0	89.3
3 3/4	15.3	20.4	25.5	30.6	35.7	40.8	45.9	51.0	56.1	61.2	66.3	71.4	76.5	81.6	86.7
3 7/8	14.8	19.7	24.6	29.6	34.5	39.4	44.3	49.3	54.2	59.1	64.0	69.0	73.8	78.8	83.7
4	14.3	19.1	23.9	28.7	33.4	38.2	43.0	47.8	52.6	57.3	62.1	66.9	71.7	76.4	81.3
4 1/4	13.5	18.0	22.5	26.9	31.4	35.9	40.4	44.9	49.4	53.9	58.4	62.9	67.4	71.8	76.3
4 1/2	12.7	16.9	21.2	25.4	29.6	34.0	38.2	42.4	46.6	51.0	55.1	59.4	63.6	67.9	72.4
4 3/4	12.1	16.1	20.1	24.1	28.1	32.2	36.2	40.2	44.2	48.2	52.3	56.3	60.3	64.3	68.3
5	11.5	15.3	19.1	22.9	26.7	30.6	34.4	38.2	42.0	45.9	49.7	53.5	57.3	61.1	64.9
5 1/4	10.9	14.5	18.2	21.8	25.4	29.1	32.7	36.4	40.0	43.6	47.3	50.9	54.5	58.2	61.8
5 1/2	10.4	13.9	17.4	20.8	24.3	27.8	31.3	34.7	38.2	41.7	45.1	48.6	52.0	55.6	59.0
5 3/4	10.0	13.3	16.6	19.9	23.2	26.6	29.9	33.2	36.5	39.8	43.2	46.5	49.8	53.1	56.4
6	9.6	12.7	15.9	19.1	22.3	25.5	28.7	31.8	35.0	38.2	41.3	44.6	47.7	51.0	54.0
6 1/4	9.2	12.2	15.3	18.3	21.4	24.4	27.5	30.6	33.6	36.7	39.7	42.8	45.8	48.9	51.9
6 1/2	8.8	11.7	14.7	17.6	20.5	23.5	26.4	29.4	32.3	35.2	38.2	41.1	44.0	47.0	49.9
6 3/4	8.5	11.3	14.2	17.0	19.8	22.6	25.5	28.3	31.1	34.0	36.8	39.6	42.5	45.3	48.1
7	8.1	10.9	13.6	16.4	19.1	21.8	24.6	27.3	30.0	32.7	35.5	38.2	41.0	43.7	46.0
7 1/4	7.9	10.5	13.2	15.8	18.4	21.1	23.7	26.4	29.0	31.6	34.3	36.9	39.5	42.2	44.8
7 1/2	7.6	10.2	12.7	15.3	17.8	20.4	22.9	25.4	28.0	30.5	33.1	35.6	38.2	40.7	43.3
7 3/4	7.4	9.8	12.3	14.8	17.2	19.7	22.1	24.6	27.1	29.5	32.0	34.4	36.9	39.4	42.8
8	7.2	9.6	11.9	14.3	16.7	19.1	21.1	23.9	26.3	28.7	31.0	33.4	35.9	38.2	40.6

Punch here to suit your binder

Technical Abstracts

Machine Tool Cost Saving

An editorial considers the progress that has been made in the last five years in machine tools. A group of machine tool men representing large manufacturers, decided that the full modernizing of a factory in which machine tools constituted the principal equipment, would result in a saving of 20 per cent in production costs since five years ago. In other words 20 per cent is a measure of the advance which American machine tool designers have made in the five year period.

Scores of instances are cited among recent advances in machine tool practices and typical of these are centerless grinders, automatic cylindrical grinding machines, planers of 90 feet a minute, speed automatic gear cutting machines and others.

These men maintain that the five years just ended has been one of the most important periods, if not the most important, in the history of the machine tool business, ranking with the introduction of high-speed steels and the revolutionary redesigning of machinery which followed. The efforts to save in production costs have followed two lines, one in the application of greater power and in mechanical ingenuity to render operations automatic or semi-automatic. The other in the production of simplified design and in seeking to make machines as nearly as possible proof against the carelessness or ignorance of unskilled men as operators.—*The Iron Age*, April 16, p. 1139.

Tool Steel Heat Treatment

S. W. Brayshaw describes the result of thousands of experiments with high class tool steel containing approximately 1.1 per cent of carbon and 0.5 to 1.0 per cent of tungsten. In these tests a number of test cutters were made as illustrated in the article and very carefully machined alike. They were annealed in many different ways and the cutters, both annealed and unannealed were then subjected to different heat treatments. One of the treatments consisted of heating the cutter direct from the cold in a carefully regulated gas-heated salt bath at 760 deg. C., for 15 minutes after which it was removed with a cold hook and quickly placed in a wire basket. The basket was plunged into water at 10-13 deg. C., so that the top of the cutter was about 4 in. or 5 in. below the surface, and swung to and fro for about 10 seconds at a fixed rate. The cutter was then allowed to remain in the water for another 20 seconds with very little motion. The test cutters, with one exception, always broke under this drastic hardening, but behaved in different ways, some cracking before they left the water, others shortly after, while occasionally the teeth continued to click for hours or even days.

This made Mr. Brayshaw think the result was due to the annealing of the steel before machining, and a second series of tests were undertaken in which the annealing process was the only variable. One hundred and two blanks were made and 100 of them were normalized by heating to 825 deg. C. in a salt bath for one hour and then cooled in the air. Two of these were machined into cutters without further treatment, and both cracked badly on hardening; the rest each received a different heat treatment and then were cooled in sand under specified conditions. Fifteen were simply heated for different lengths of time, varying from 1 to 16 hours to a temperature at or below the hardening point. The others were first heated for an hour to a temperature of 750 deg. C., 800 deg. C., 850 deg. C. or 900 deg. C. and then quickly transferred to a second furnace at a temperature below the hardening point, and kept there for times varying from 15 min. to 16 hours, then cooled in sand.

After being hardened, the cutters were dried and dipped into oil and then sand blasted in order to facilitate the discovery of cracks. Marks were assigned to each cutter according to the cracks observed, and the different heat treatments could thus be compared. From the results obtained it appears that there is a range of temperature of about 715 deg. C., to 728 deg. C. within which, with prolonged soaking, the steel reaches a condition in which the danger of cracking on subsequent hardening is at a minimum. Blanks which have been soaked for a sufficient time within this range make good cutters in respect to cracks on hardening, even when the temperature in the first furnace was as high as 900 deg. C. although such preliminary treatment weakens the steel.—The *Metallurgist Supplement* to *The Engineer* (England), May 29, p. 73.

Economic Efficiency of the Full Automatic Turret Lathe

R. J. Wadd, chief engineer of the Shepard Electric Crane and Hoist Co., describes how certain work increased in volume so larger sized lots had to be run through the shop, which opened up the possibilities of new machine tool equipment. One of the economic changes made was from the semi-automatic turret lathe, employing one power-feed cutting position per operation, to the full-automatic type turret lathe with one or more power-driven cutting positions per operation on parts that would allow tooling for the cutting of more than one tool per operation. The former required an individual operator per machine, while with the latter two or more machines may be grouped.

Before the required number of automatics and their tool equipment could be installed it was necessary to produce some of the parts on semi-automatic turret lathes. These lathes were practically new machines and all calculations are based on their original investment charge. As the parts were swung over to the automatic turrets for production, actual costs of identical parts on the two types of machines became available.

The balance of the paper is largely a mathematical analysis and it serves to determine very forcibly the economic possibilities of the full-automatic turret lathe on quantity production.—*Mechanical Engineering*, May, p. 411.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

Beginning Volume 63

WITH this issue the "American Machinist" commences its sixty-third volume. Established in 1877, the paper has forged steadily ahead, a mirror of the progress in the mechanical arts and a leader in the thought of the metal-working industry. During its nearly forty-eight years, the "American Machinist" has not changed its name nor has it absorbed any other papers or combined with any.

The present editorial staff consists of Kenneth H. Condit and Fred H. Colvin, editors; A. L. DeLeeuw, consulting editor; L. C. Morrow, managing editor; and S. A. Hand, Ellsworth Sheldon, John Younger, W. E. Irish and Frank W. Curtis, associate editors.

The Silver Lining

EVEN the oppressively gloomy cloud of mounting costs has its silver lining. There can be no doubt that it has brought with it many very real ecomomies and a great increase in industrial efficiency.

One evidence of the change can be found in the census figures. In 1923 manufacturing plants in the United States produced by volume 65 per cent more goods than in 1914 and this with an increase of only 25 per cent in personnel. Probably the greater productive efficiency of the later date is due largely to improved and enlarged installations of labor saving machinery. If the surmise is correct we must score a big point to the credit of the machinery builders.

A more conclusive proof is the rapidly growing interest in industrial simplification. Manufacturers in all sorts of lines are awakening to a keen interest in the project and much is being done at conferences to reduce the number of sizes and grades of all sorts of products. Here, without question, is real economy.

All in all, the indications point to a stronger will to save and improve, a most healthy sign of future prosperity.

Reducing the Dead Weight per Passenger

THE automobile has frequently been criticized as a passenger carrying vehicle because of its limited seating capacity. And it does not seem that motor vehicles carrying from two to five passengers provide such an economical method of transportation that they can seriously affect railway traffic.

There is, however, no doubt that the total number of passengers carried by automobile and motor-bus, or motor-coach to call it by its new name, would make a great addition to that already carried on the railway. One phase of the question that is usually overlooked has a direct bearing on the economies involved in the matter. This is the question of dead weight per passenger, which is very much in favor of the motor vehicle. A small five-passenger car has about 360 lb. dead weight per person while the motor-coach sometimes gets as low as 280 lb. per passenger. The weight of a standard railway car is given as 1,900 lb. per passenger while a Pullman runs up to 5,900 lb. per seat.

While weight alone is not the deciding economy factor of the situation, it has an important bearing on costs. If it is possible to reduce the dead weight per passenger in railway cars, and many contend that it is, transportation costs may be materially affected in the future. It is possible that either the use of some of the lighter alloys or of stronger steels may help to reduce the dead weight of railway rolling stock to an appreciable degree.

New Policies of the F. T. C.

SOME of the new policies of the Federal Trade Commission are of special interest to business men in general. As set forth by W. E. Humphries, a new member, at the annual meeting of the United States Chamber of Commerce the following points were of special interest:

No publicity is to be given to complaints until the case has been tried and the party found guilty. This is to be commended from all points of view.

Evidence submitted voluntarily will be considered as confidential.

No cases of unfair practice between corporations will be taken up where no public interest is involved, such as a dispute involving trade-mark and nothing else.

Cases that are evidently trivial in character will not be taken up, thereby saving time for the more important decisions. There is, however, no change in the attitude of the Commission toward business that is really crooked in any way. The object of the Commission to promote fair dealing remains the same.

In summing up Mr. Humphreys expressed the opinion that the Commission did not believe that success was a crime or failure a virtue; that wealth was always wrong or poverty always right; that big business and crooked business were synonymous. The Commission believes that 90 per cent of American business is honest, and anxious to obey the law, and they want to help the 90 per cent, just as they want to destroy the 10 per cent that is crooked.

Shop Equipment News

Heald Semi-Automatic Internal Grinding Machine

The Heald Machine Co., of Worcester, Mass., has brought out an improved grinding machine of the internal type, to be known as the "semi-automatic," in the operation of which many of the minor movements that have hitherto devolved upon the operator are taken care of by the automatic mechanisms, and the sizing is done by means of a direct-reading indicator. For this reason the builders claim for this machine a greatly increased productive capacity and greater uniformity of output. In Fig. 1 is shown a front view of the machine and Figs. 2, 3 and 4 show details.

After the operator has placed a piece of work in the chuck or holding collet and secured it by a movement of the chucking lever *A*, Fig. 3—at which time the traversing table, carrying the wheel-head, is at its extreme outward position and at rest—he tips forward the reversing lever to the position shown and thereby brings into action the sequence of automatic movements as follows:

The table advances at full speed until the grinding wheel reaches a position where it is about to enter the hole to be ground, when the movement automatically slows to the predetermined rate of traverse and continues to reciprocate at that speed within the limit of stroke imposed by the depth of the hole. At the same time the automatic cross-feed comes into action to feed the wheel to the work by increments also previously determined and in accordance with the nature of the material to be ground. The feed movements may take place at either or both ends of the stroke as desired.

When the size of the hole has reached a point about 0.003 in. below the finish diameter required—a point that is also adjustable at will—the rate of feed automatically slows to an arbitrary increment of 0.0002 in. per table stroke. The operator, being made aware of the approach to finish size by this change, and by the reading of the indicator, proceeds to dress the wheel by lifting a finger latch connected to one of the reversing dogs, without altering the setting of the latter, thus allowing the table to run out to the desired degree of amplitude. At the same time he lowers the diamond to dressing position by pulling forward the knob *C*, and also slows the rate of traverse of the table to a predetermined low limit by pushing the control lever, called the throttle, to the right against a stop.

One pass, back and forward, is made over the diamond to true and sharpen the wheel, after which the table returns automatically to its former limits and rate of traverse, pushing back the diamond as it does so. The feed continues at the rate of 0.0002 in. until finished size is shown by the pointer of the indicator.

The dial indicator is connected to a bar, a finger on the inner end of which enters the hole being ground and is tipped at this point with a diamond that bears continuously against the wall of the hole at a point opposite to the contact of the grinding wheel. The size of the hole is thus constantly under the observation of the operator, who has little to distract his attention from the indicator.

When the pointer of the indicator reaches zero the operator depresses the treadle, allowing the table to run out to the right—again at full speed—until it comes to rest in its original position. The rate of traverse while the wheel is grinding or being dressed is determined by the position of the control lever and may be anything from zero (if the lever is in its *extreme* right position the table will not move) to a maximum of 50 ft. per min. As soon, however, as the table passes beyond the control of the reversing dogs it resumes its maximum speed, regardless of the position of the control lever.

Though nearly all of the movements described are taken care of by the normal functioning of the automatic mechanisms they are all, and at all times, instantly amenable to manual control and may be stopped, started or reversed at will of the operator without reference to the automatic features.

The work spindle is large and has a 1¼-in. hole passing axially through the center. It is provided at the

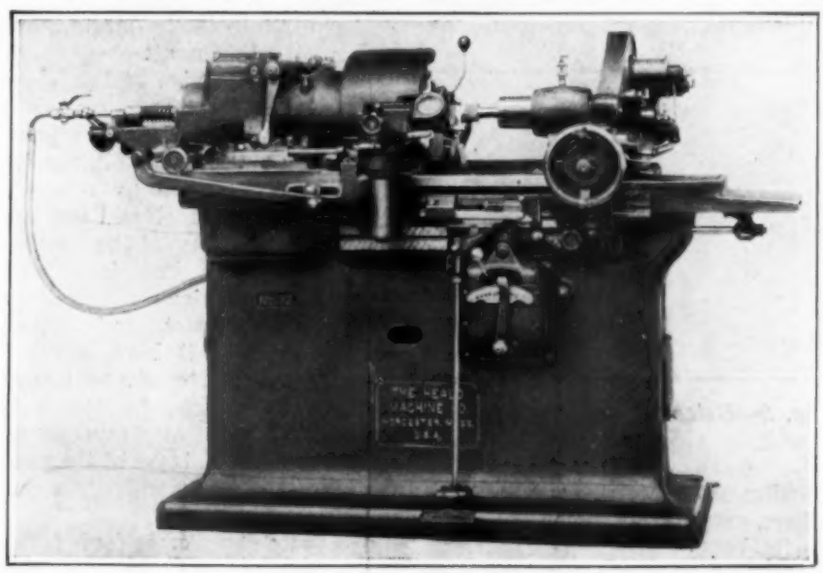


Fig. 1—Heald Semi-Automatic Internal Grinding Machine

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front end with a flange against which the chucks or other work-holding fixtures may be seated accurately and securely. It is designed to take push or pull collets as desired, and either may be operated by a single movement of the same lever (*A*) by merely changing one connection at the rear end of the spindle.

The spindle runs on ball bearings, a single-row bearing at the rear and a matched pair of single-row bearings with ground spacers between them at the front end initially adjusted under a considerable degree of end pressure. The bearings will run indefinitely without further adjustment, and will permit neither radial nor end play of the spindle.

The drive is by belt to a flanged pulley, integral with which is one member of a cone friction clutch, the other member being keyed to the spindle. The clutch is held normally in engagement by the pressure of coil springs. When the clutch is disengaged by a movement of the lever *G*, the clutch pulley rotates idly upon a sleeve bearing of bronze that surrounds the spindle. This is the only plain running bearing in the machine (unless plain bearing wheel

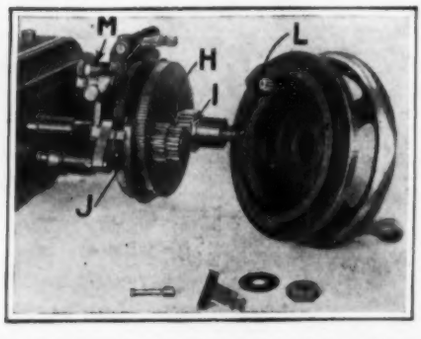

Fig. 2—Detail of automatic-feeding device

spindles are specially ordered) all others, even to those upon the minor shafts, being standard ball bearings.

Water is delivered upon the work through the central hole of the spindle and its flow is controlled by a valve that is operated in conjunction with the clutch, so that a movement of the clutch lever to stop the rotation of the spindle also cuts off the supply of liquid, and at the same time applies a brake to bring the spindle to rest quickly. The act of restarting the spindle automatically turns on the water.

The head is mounted upon a circular base that provides means for preserving alignment. The entire head is enclosed so that no rotating part is exposed. A work guard covers the work to the greatest possible extent consistent with convenience to confine the water or other liquid used upon the work and prevent spraying. The upper part of this guard is hinged and held in closed position by the tension of a spring so that it may be thrown back with a minimum of effort when necessary to get at the work-holding fixtures.

The work head is mounted upon a stationary bridge that spans the slide-way upon which the traversing table takes its bearing, so that the forward extension of the table may pass under it and provide ample support to the wheel head in all positions. The wheel head is mounted upon a secondary slide at right angles to the ways of the table and is moved by a cross-screw that is actuated through reduction gearing from a handwheel with micrometer graduated dial; and also by the automatic feeding mechanism.

The power to traverse the table is applied through the medium of a hydraulic cylinder attached to the base of the machine and a piston that through its connecting rod is attached to the table. The power transmitting medium is oil, supplied under high pressure by a geared pump, made by the Heald company and integrally a part of the machine. This mechanism has been fully described in previous issues of the *American Machinist*, and nothing need be said of it here except to direct attention to the automatic features by which the length of stroke and rate of traverse are altered at certain stages of the work, features that are specifically a part of this machine.

The automatic cross-feed is applied through the epicyclic gear train of the unit shown partly disassembled in Fig. 2. The bronze pinion *H* at the center of the train is permanently affixed to the housing of the ball thrust bearing of the cross-screw and does not rotate. The steel pinion *I*, just beyond and in line with *H*, is keyed to the screw.

The ratchet and its connected disk gear, from the face of which projects a stud upon which the planetary gears are free to rotate, revolves upon an independent bearing surrounding the cross-screw and drives the latter only through the epicyclic train. The handwheel with its graduated dial also revolves freely upon the projecting end of the cross-screw and is connected to the ratchet so that the screw may be turned either by hand through the wheel or by the automatic mechanism through

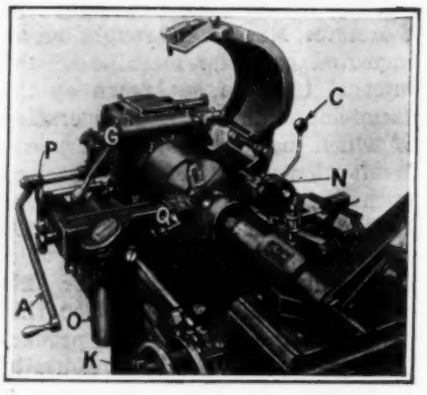

Fig. 3—Detail of wheel dresser and automatic size-indicating device

the pawl and ratchet. The connection between the ratchet and the handwheel is not, however, a rigid one, and the wheel may be rotated relative to the ratchet by means of a device to be described.

The reduction ratio of the epicyclic train is such that though the cross-feed screw itself is 1¼ in. in diameter and of ⅛-in. lead, one complete turn of the handwheel and dial advances the cross-slide but 0.03 in. The ratchet has 300 teeth, each representing an advance of the slide of 0.0001-in., or 0.0002-in. when measured on the diameter of the work.

The automatic change of feed from roughing to finish grinding takes place within this unit. Any number of teeth of the ratchet may be included in the roughing feed, but when the diameter of the hole has reached a point 0.003 in. less than finished requirement (more or less, according to the manual setting of the cam on the first piece) the cam-lug *J* lifts the pawl partly out of engagement and limits its effective travel to one tooth of the ratchet.

As the grinding wheel reduces in size from normal wear and continued redressing it is necessary to make compensation manually in order to have the automatic feed stop at the right place. This is done by

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turning back the small star-wheel *K* (see Fig. 3) near the rim of the handwheel, which turns the pinion *L* (Fig. 2) and rotates the sizing mechanism backward with reference to the ratchet. The star-wheel and pinion are restrained against free rotation in their common bearing by a spring detent that requires an appreciable effort on the part of the operator to overcome. Consequently the rotation takes place in a series of steps, or "clicks," each click corresponding to one tooth of the ratchet. This compensation must be made whenever the automatic feed reaches its limit and goes out of action before the dial sizing indicator records the finish size. As before stated, each backward step of the star-wheel compensates for a loss of 0.0002 in. in diameter of hole.

Provision is also made in this unit to avoid the necessity for "cut and try" when replacing a worn wheel with a new one. When the machine is first set up, and with a new wheel on the spindle, the cross-slide is drawn back against the swinging stop *M* and in this relation the new wheel is dressed off with the diamond. On substituting a new wheel for an old one it is thus necessary only to bring the slide in the same relation, dress off the new wheel as in the first place and proceed, with the certain knowledge that the new wheel will enter the rough hole exactly as did the first one.

The bracket supporting the diamond-dressing tool is mounted on a slide on the base of the machine, and, once set to position, has no further movement during a run. The tool itself is hinged to the bracket and rests normally in the position shown at *N* in Fig. 3, where it is out of the way of the moving wheel-head. When brought down to active position by pulling forward the knob *C* the point of the diamond is level with the center line of the machine and distant from it by an amount that is slightly less than the radius of the hole to be ground. In this, as in all of the newer internal grinding machines made by the Heald Machine Co., the wheel grinds at the back of the hole.

The diamond is held in the position shown at *N* by a cam affixed to the table of the machine and cannot, therefore, be lowered to the dressing position until the table and wheel-head have been run back out of the way. If the operator does not restore it to position after dressing the wheel the cam will push it up as the table advances, so that no collision is possible.

The essential elements of the sizing device are a dial indicator and a pivoted bar, the inner end of which is hooked to enter the hole being ground and tipped at this point with a diamond which bears continuously upon the wall of the hole at a point opposite to the contact of the wheel. The casing in which the mechanism is housed swivels in a horizontal plane about a bearing in the pocket *O*, and it is held in position against a stop by a torsion spring.

The position of the hooked bar may be adjusted in and out by means of the knob *P*, and a latch, actuated by the small lever *Q*, holds it forward against the action of a light spring, so that when the hook is entered in a rough hole upon starting a new piece of work, the diamond need not ride upon the rough surface with consequent danger of breakage.

When the table is run out to change the work in the collet a cam affixed to it contacts with a roller on the under side of the case and swings the indicator housing to a position nearly at right angles to the working position. This movement is entirely automatic, and the operator pays no attention to it except to lift the lever *Q* with his finger after the new piece has been ground long enough to insure the removal of its rough surface.

In Fig. 4 is a comprehensive view of the rear of the machine showing the arrangement of auxiliary shaft, pump and piping. All of those parts are on the outside and readily accessible. There is practically no mechanism concealed within the base, that space being occupied by the closed tank that holds the oil used in the hydraulic cylinder.

A separate and portable tank is provided to hold the water used on the work. This tank (not shown) is of heavy steel plate and contains, beside the centrifugal circulating pump, strainers and settling compartments to rid the liquid of entrained dirt and abrasive particles.

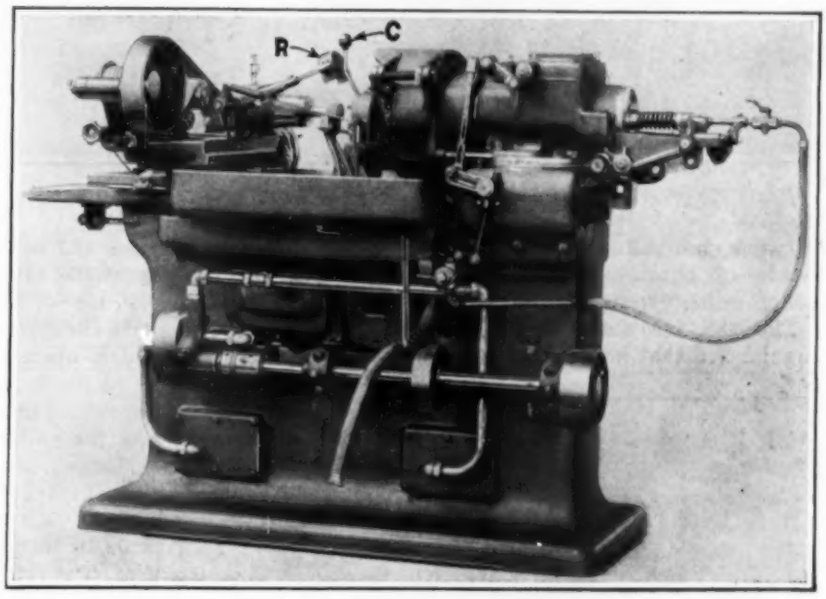


Fig. 4—Rear view of machine

The machine is driven from overhead countershafts, which are supplied with it. A pair of 5-step cones on the countershafts provide a corresponding number of changes of speed to the work spindle. The rate of table traverse is governed entirely within the machine, and may be anything from zero to 50 ft. per min. without abrupt graduations.

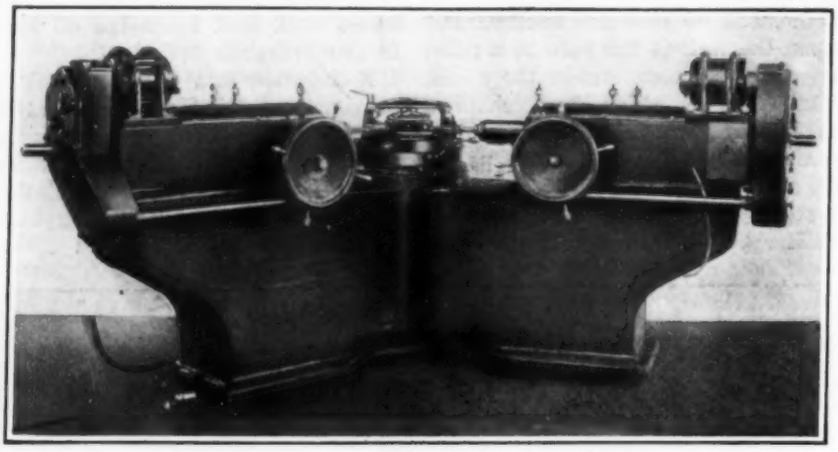
The wheel spindle and housing is a self-contained unit and is quickly interchangeable with others of different size, length or type.

The machine occupies a floor space of 50 x 96 in. and weighs approximately 5,500 pounds.

SHOP EQUIPMENT NEWS

Pratt & Whitney Differential-Housing Boring and Reaming Machine

The Pratt & Whitney Co., 111 Broadway, New York, N. Y., has developed a single-purpose machine for boring and reaming the three holes that carry the pinions in automobile differential housings. The machine is suitable for various sizes of work, and offers a satisfactory means of obtaining rapid production for this class of work.



Pratt & Whitney Differential-Housing Boring and Reaming Machine

The machine consists of a large angular bed that mounts two boring-head units, having individual motor drives. The units are mounted at an angle of 120 deg. to each other, with the work indexing fixture at the apex of the angle. In this manner a correct angle between the two spindles is maintained, and the operation is continuous as one spindle bores while the other reams. The bed, made solid to avoid vibration, forms a rigid foundation so that accurate work may be accomplished.

The Work-indexing fixture

The long spindle quill, mounted in heavy bearings, may be hand-operated by a rack on the underside of the quill that engages the hand-wheel pinion. A 1½-hp., 1,150 r.p.m. motor, mounted on the top of the head, is geared directly to the spindle through a friction clutch operated by a lever located behind the hand-wheel. The boring bar is mounted in the usual manner in the spindle nose that has a No. 4 Morse taper.

The left-hand head is geared to give a boring speed of 350 r.p.m., with a power feed of 0.010 in. per revolution of the spindle. The right-hand head has a reaming speed of 150 r.p.m. with a feed of 0.060 in. per revolution of the spindle. The speeds and feeds may be altered if desired by substituting different gears in the two gear boxes. The oiling of the heads is accomplished entirely through sight-feed oil cups, with the exception of the gear boxes that are lubricated from a large reservoir located in their top portion.

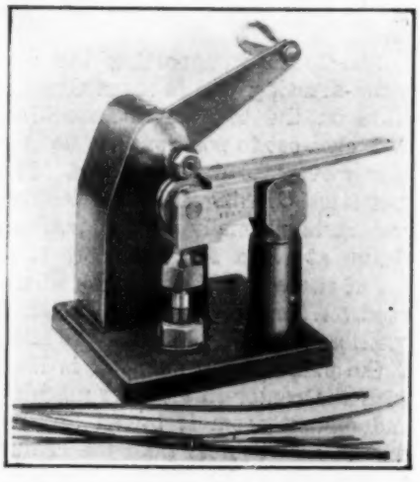
The work casting is held in place by an overarm that clamps with a convenient binder. Three hardened-steel shoes on the underside of the holding plate are removable, and are the only changes necessary to accommodate the various sizes of work. The table, indexed by hand, is provided with a locating pin operated by the lever projecting through the bed. A binder that consists of a split sleeve, extending around the table, holds it tightly in position during boring. The binder has a taper-inside surface that forces the table down tightly against the bed, insuring the work being held accurately in place against the locating surface.

Floating bushings on the boring and reaming bars fit into the guide holes on the upper surface of the table and form a support for the bars. These holes also provide a means of locating the work by using a taper-locating pin. The pin is tapered to accommodate holes from ¾ to 1½ in. in diameter, being the range of sizes for which the present machine is made. The table indexing ways are lubricated by rolls and reservoirs similar to that of a planer table.

Noble & Westbrook Marking Machine, Bench Type

The marking of gold solder, that required a continuous mark to designate its quality, led the Noble & Westbrook Manufacturing Co., 19 Asylum St., Hartford, Conn., to develop the small bench marking machine, as illustrated. The material is fed into the rolls, operated by turning the crank handle, and stamped as it passes between them.

The machine is of the continuous-roll type, having a capacity for strips from ⅛ to ¾ in. in width. There is an adjusting screw by which the lower roll may be raised or lowered, and stock of different thicknesses



Noble & Westbrook Marking Machine, Bench Type

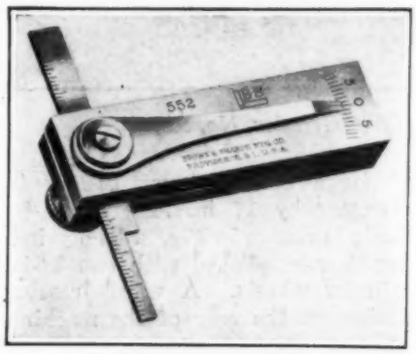
SHOP EQUIPMENT NEWS

marked. A gage arm is used to guide the strips through the rolls, the lower roll being grooved to carry the metal to be marked. The upper roll is the marker and accommodates letters $\frac{3}{32}$-in. long, or less.

The crank is geared to the rolls by a ratio of 2 to 1, so that rapid production is insured. The gears used are mounted within the frame casting. The machine weighs 10 pounds and is rigid in construction. Two holes are provided in the base so that it can be suitably bolted to any bench.

Brown & Sharpe Diemakers' Square, No. 552

The Brown & Sharpe Manufacturing Co., Providence, R. I., has added to its line of small tools the diemakers' square illustrated, intended for various uses connected with die-



Brown & Sharpe Diemakers' Square, No. 552

making, patternmaking and toolmaking.

The square may be used for establishing clearances of drop-forging dies, drawing and forming dies, die castings and for checking drafts of patterns. It can be used as a square or a protractor, as it has graduations on the body that read 8 deg. on either side of zero. It is provided with a knurled-nut clamp so that it can easily be locked.

The blade, that can be adjusted to suit, is provided with a narrow and a wide end, making its application suitable for use in many places that cannot be reached with the ordinary squares. The blade, accurately graduated 1 in. from either end, has 32nd sizes on one side and 64ths on the other. The narrow end is $\frac{3}{4}$ in. and the wide end is $\frac{7}{8}$ in. The body is hardened and ground.

Van Norman Turning and Grinding Machine No. 96

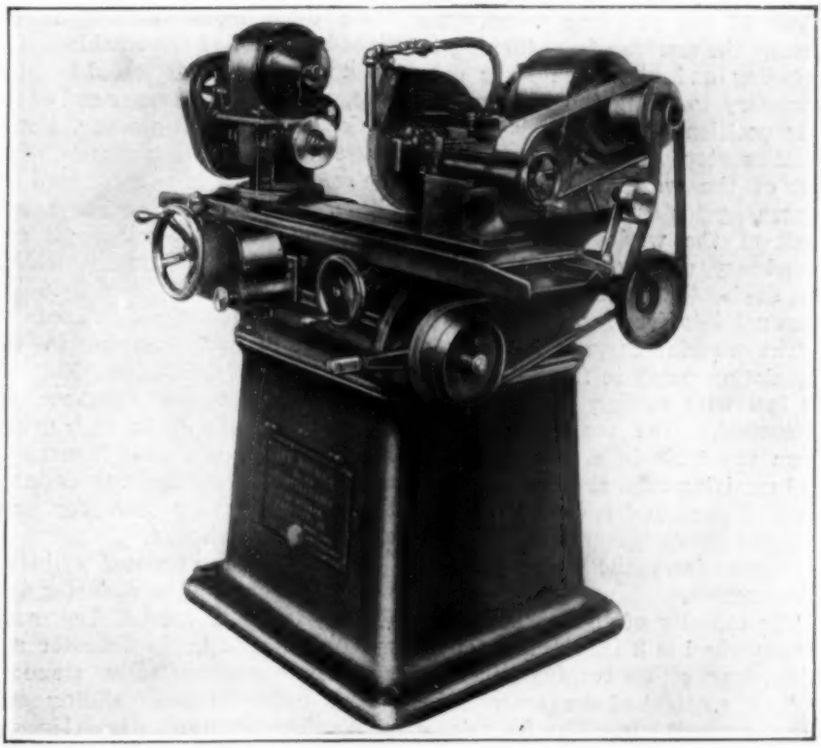
The Van Norman Machine Tool Co., 160 Wilbraham Ave., Springfield, Mass., has placed upon the market a machine primarily designed to turn and grind the pistons of automotive engines at one setting, but which is equally capable of performing the same operations upon any round work of similar nature within its capacity.

The table of the machine has a traverse movement of 15½ in. along the shears and is actuated by power in both directions. Six traverse speeds are available through the medium of a pair of three-step cones and belt operating in conjunction with a train of speed-reducing gears. With the gears interposed the three table speeds are calculated for the turning operation. With the gears thrown out by the movement of a lever the speeds are suitable to grinding.

The spindle of the workhead runs in bronze bearings with suitable means of compensating for wear, and is driven by a ½ hp. motor, mounted upon the head and driving through a train of change gears, that provided three rates of rotative speed. The spindle is hollow and is fitted with a drawback tube and spring collets to hold work up to ¾ in. in diameter. A faceplate is screwed on the spindle nose, and to this plate may be fitted adapters of different sizes, each having a 60-deg. beveled corner to act as a center for the skirt end of a piston of corresponding size.

The adapters are centered upon the faceplate by a hub, or boss, that fits a counterbored recess at the center of the plate, and are held against relative rotation by dowel pins. The drive to the piston is by means of an adjustable dog that fits in a radial slot in the face of the adapter, secured by an extra draw-rod passing through the center of the regular draw-tube and tightened by a separate handwheel. The adapters must be changed to correspond with the size of the piston being ground. The driving dog adjusts to any diameter. The "tail" of the dog drives against the piston-pin boss.

The wheel spindle runs in ball bearings and is driven by belt from



Van Norman Turning and Grinding Machine No. 96

SHOP EQUIPMENT NEWS

a 1½-hp. motor that is clamped to the table of the wheel-slide. The belt is 3-in. wide and is endless, tension being maintained by adjusting the position of the motor upon the slide. The wheel-slide has a cross movement of 6 in., which is actuated by a handwheel at the front of the machine. The rim of this handwheel is graduated to 0.001 in. of advance.

The grinding wheel, when new, is 12 in. in diameter by 1-in. face, with a 1¼-in. hole. The centers will swing 10 in. over the table and will take a piece of work 15 in. in length; the machine turning and grinding the work at one setting but in consecutive operations.

Though the table is traversed by power in either direction, it does not reverse automatically, the reverse being accomplished manually by means of a conveniently placed lever. When the machine is set for turning, the table acts as the carriage of a lathe, moving along the shears until it contacts with a stop to disengage the fed. This stop is adjustable to any desired position, and serves also to stop the table when the machine is grinding.

The turning tool is a square-sectioned bit of high-speed steel, held in a swinging holder that may be seen in the illustration just to the right of the grinding wheel. To change the machine from turning to grinding and vice-versa it is only necessary to swing the tool upward into position, where it is held by a positive stop, or to swing it down out of the way. The tool is, of course, upside down and cuts at the back of the work. The grinding wheel may, or may not be allowed to run during the turning operation. It does not interfere in any way.

The machine is provided with a circulating pump to flood the wheel or tool with cooling or lubricating compound. The compound drains from the table to a settling basin and receiving tank at the rear of the base. Power to drive the pump and also the power traverse of the table is taken from the pulley of the wheel motor.

The capacity of the machine with a new wheel is 8 in. in diameter by 15-in. long, either turning or grinding. The height of the centers from the floor is 41½ in. The floor space occupied is 50 x 64 in. The net weight is 1,500 pounds.

Badger Double-Spindle Grinder, No. 224

The double-spindle grinder illustrated has been marketed by the Badger Tool Co., Beloit, Wis. It is the largest machine of this type built as a regular part of its line. The grinding principles employed are similar to those used in the smaller double-spindle grinders, but because of the increased dimensions throughout, the No. 224 machine is suitable for finishing larger areas than has been practical heretofore.

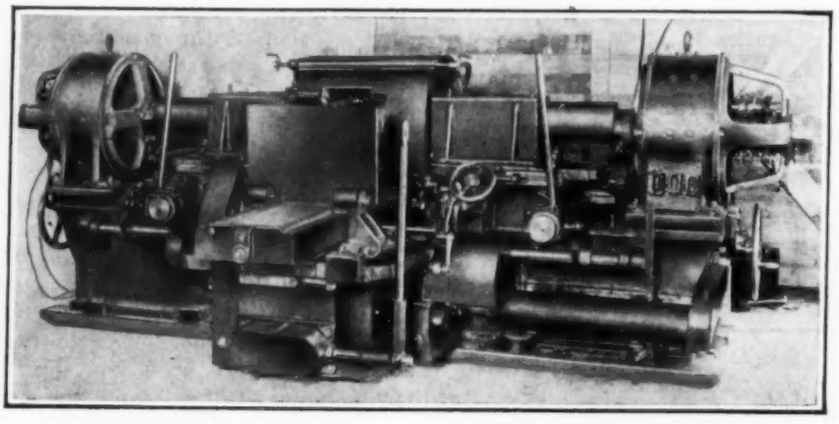


Fig. 1—Badger Double-Spindle Grinder, No. 224

The sliding worktable is operated through reduction gears by a separate 3-hp. motor located at the right-hand end of the machine. The work to be ground is placed in a fixture, attached to the inner end of the worktable, that reciprocates slowly between the grinding wheels when the control lever is in a forward position. When the lever is thrown back, the worktable comes out and stops, in which position the holding fixture is loaded. The grinding heads are opened and closed by power in proper relation to the cross travel of the table. Suitable micrometer stop screws are provided to act independently on each grinding head. A ratchet feed is mounted so the head can close one or more thousandths of an inch for each cycle of the worktable.

Either 24-in. diameter cylinder-wheel chucks or 30-in. diameter disk wheels may be used. The main spindles are 3⅞ in. in diameter and each is connected to a standard 20-hp. motor through sliding couplings. The longitudinal travel in each sliding head is 2 in., being ample for any one particular set-up, but when large changes of opening between wheels is required, the sub-slides, on which the motors are mounted, may be moved to the desired position and locked on the ways of the bed. The maximum opening between the cylinder-wheel chucks is 24 in. and between the disk wheels is 30 inches.

A view of the machine in operation grinding the two parallel ends of large coil springs, 10 in. in diameter by 17 in. long by 1¼-in. stock, is shown in Fig. 2. The grinding is accomplished with two 24-in. cylinder wheels. A wheel-dressing device, on the rear of the machine, enables the wheels to be dressed while the work is being ground.

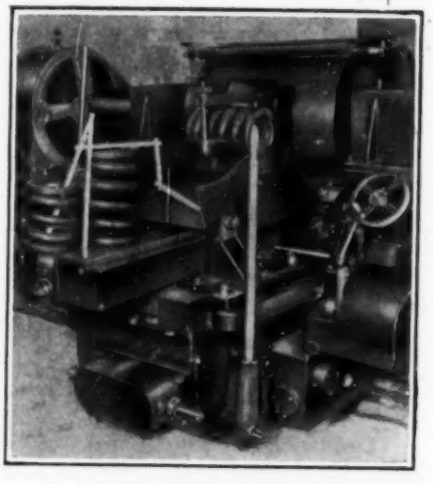


Fig. 2—Grinding coil springs

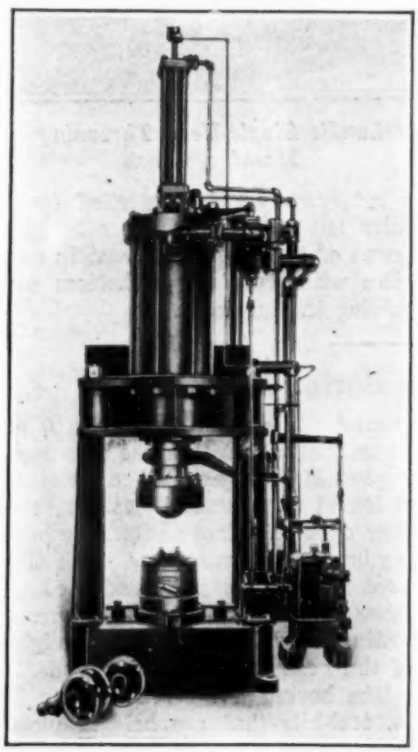
The machine is built for either belt or motor drive and is arranged for wet or dry grinding. It is 15 ft. long by 7 ft. wide and weighs 14,000 pounds.

SHOP EQUIPMENT NEWS

Oilgear High-Speed Hydraulic Press

The hydraulic press, shown in the illustration, has been added to the line of equipment manufactured by the Oilgear Company, 655 Park St., Milwaukee, Wis. It is intended for straightening malleable-iron and steel castings and is built in two sizes, 50 and 100 ton.

The press is equipped with a high-speed cylinder for advancing and withdrawing the ram to and from the work rapidly, cutting the time required for traversing the ram through the loading space. The pressing action is accomplished by a large cylinder. The flow of oil from the pump to the press is controlled by a single-foot pedal, allowing the operator to have both hands free. As the dies come into contact with the work, an automatic valve shifts the flow of oil from the high-speed traversing cylinder to the large squeezing cylinder automatically. When the casting has been straightened, the ram is returned quickly to its upper position by the small cylinder. The control mechanism is equipped with adjustable stops, so that the ram may be stopped at any point in its stroke. The ram never travels more than is necessary to clear the work and to permit loading and unloading of the dies.



Oilgear High-Speed Hydraulic Press

It is claimed that with the smooth flow of oil to a hydraulic cylinder under perfect control, the castings are subjected to a quick squeeze rather than a sudden blow, that results in giving the metal time to flow properly, and that castings retain their proper shape instead of springing back.

W. F. & John Barnes Four-Way Automatic Drilling Machine

A machine intended for drilling small parts, having four holes spaced at 90 deg. around the periphery, has been added to the line of drilling equipment manufactured by the W. F. & John Barnes Co., Rockford, Ill. It is capable of completing an entire series of cycles in six seconds, so that small metal stampings may be drilled in this time.

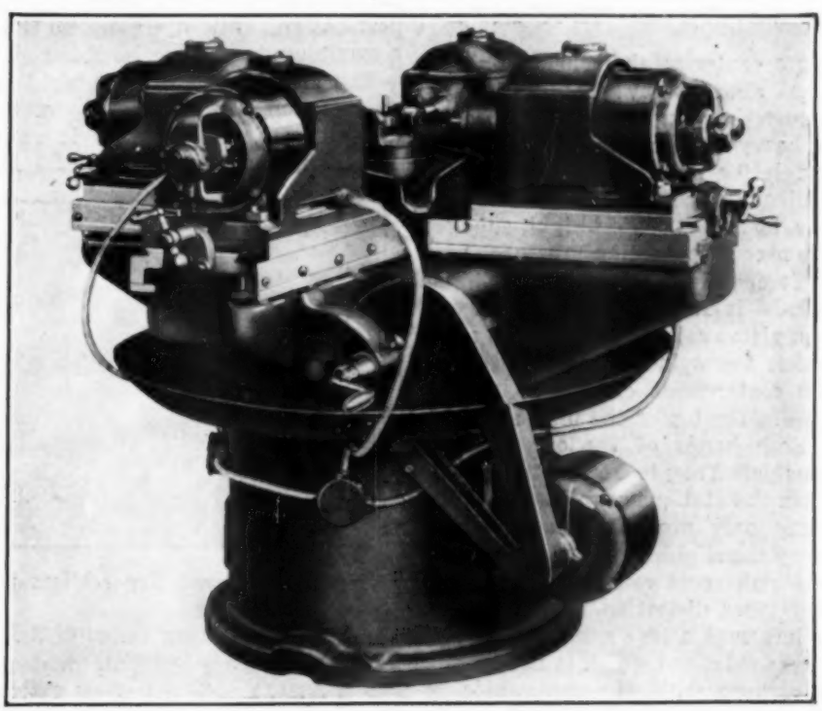
The machine consists of the base, onto which is mounted a four-way casting, carrying four slides. These slides are equipped with auxiliary slides for the necessary adjustment of the motor and the spindle housing in an inward and outward motion. The auxiliary slides carry the drill spindles that are directly driven from the armature shaft of the motors.

The operation of the machine is completely automatic. There is a rapid movement of the heads to the work, then the heads are slowed down to a drilling speed. When the desired drilling operation has been completed, a quick return of the spindle takes place and the cycle is complete.

The four heads operate by means of a face-cam carrying a roller that is fixed to the slide carrying the motors and drills. A separate motor is used to drive a worm and wormwheel, to which is attached the cam. A handwheel is furnished so the entire mechanism may be operated for setting up the machine. The internal mechanism is lubricated by an automatic lubrication system.

Van Norman "Ko-rek-tor"

The Van Norman Machine Tool Co., 160 Wilbraham Ave., Springfield, Mass., has brought out a bench device for correcting the bevel at the skirt end of a piston so as to leave a true center upon which to grind it. Oversize pistons held in stock to be fitted to individual motors



W. F. & John Barnes Four-Way Automatic Drilling Machine

SHOP EQUIPMENT NEWS

are apt to become slightly distorted. When a casting thus distorted is forced against a true center in the grinding machine the distortion is temporarily overcome, only to reappear when the piston is taken out of the machine.

In this device a 60-deg. center-reamer with adjustable inserted blades of high-speed steel is fixed to the base and a sliding spindle, carrying a center-point, is held in alignment above it by passing through the overhanging boss of the bracket. A heavy knob on the upper end of the latter spindle provides a convenient means of manipulating it and, by virtue of its weight, supplies the necessary feeding pressure.

Van Norman "Ko-rek-tor"

To operate the device, the sliding spindle is raised and the skirt end of a piston set over the reamer, after which the spindle is lowered until the center-point enters the center-hole in the top of the piston.

Both hands of the operator are thus left free to rotate the piston upon the stationary reamer. A few turns only are required to scrape away the slight excess of metal upon the high spots caused by the above mentioned distortion, and the piston is left with a true concentric center at the skirt end which is in accurate alignment with the center-hole at the top. Pistons up to 6 in. in diameter can be accommodated.

Landis Single-Head Threading Machine, ½-Inch

The Landis Machine Co., Waynesboro, Pa., has placed on the market the single-head threading machine, illustrated, that has a capacity of ½ in. It is provided with a geared headstock and a single-pulley drive, and has four speeds, so that the diehead can be operated at 157, 226, 315 or 441 r.p.m. The power is transmitted from the motor shaft to the drive shaft by means of a belt.

The diehead is opened and closed automatically at predetermined limits by an adjustment screw on the carriage, or by hand. The vise used for gripping the work has a horizontal-sidewise and a vertical-centering adjustment. This feature gives perfect and permanent alignment with the die and is exclusive with the machine. A full supply of cooling lubricant at the diehead, maintained by a rotary pump, is controlled by a valve located at the diehead. The frame of the machine is cast in one piece with a fluid-tight bottom for holding the lubricant.

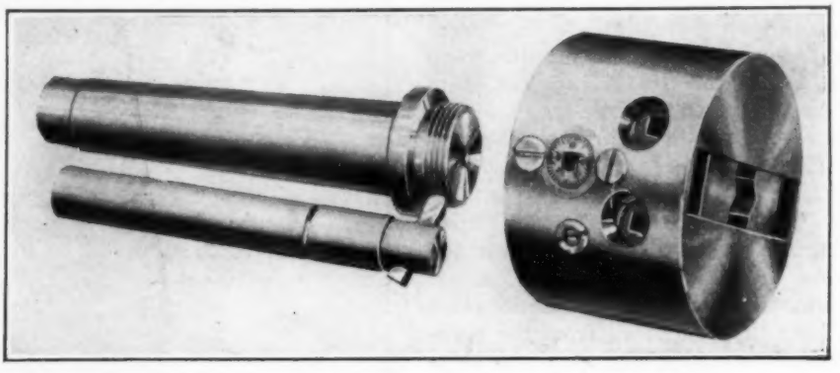
Landis Single-Head Threading Machine, ½-Inch

Flynn Super-Micrometer Boring Head No. 20

A boring head, designed for heavy-duty work on boring and milling machines, has been added to the line of tools manufactured by the J. T. Flynn Manufacturing Co., and marketed by J. M. Waterston, 427 Woodward Ave., Detroit, Mich. It is compact in design, having no protruding portions and little overhang, so that a maximum travel may be obtained.

The body of the head is rigid in construction, measuring 7½ in. in diameter and 3½ in. long. It runs concentric and has an offset of 1 in. that enables a boring range of 2 in. in a complete revolution without changing the boring bar or cutter. The jaws and jaw screws are made of nickel steel, heat-treated and ground. The jaws open from 0 to 1½ in., permitting the use of a boring bar of that size. When the slide is locked in a central position, the jaws open and close so that the boring bar or drill runs true. The dial used for adjusting is graduated in thousandths of an inch so accurate settings may be made. The weight of the boring head is 28 pounds.

The boring bar accommodates ¼-in. tool-bits that are held in place by a steel ball that is forced against the bit by the turning of the end of the bar. This method insures a positive grip and eliminates set-screws. The shank can be furnished either with Nos. 5 or 7 Morse taper or Nos. 12 to 16 B & S taper.



Flynn Super-Micrometer Boring Head, No. 20

News of the Week

Immigration Legislation an Important Problem for Next Session of Congress

Urgent need for classification of labor supply

Work on immigration legislation will begin immediately on the reassembling of Congress. In fact most members of the committees on immigration are improving the interim between sessions in familiarizing themselves with the problems they soon will be called upon to solve.

The new quota law now has been in effect a year. It has accomplished its major purposes in that it has reduced the volume of immigration and has increased the proportion from the North of Europe. The figures for the first ten months of its operation show that of the European arrivals under the law eighty-five per cent are from the countries of Northwestern Europe. The old quota law, the one in effect from July 1, 1921 to July 1, 1924, divided European immigration almost equally between the countries of the South and those of the North.

Need for Data

One of the urgent necessities is the setting up of fact-finding machinery so as to determine accurately what are the needs of the country. At present one area may have a surplus of some type of skill when another area may have a shortage. Some means must be found, it is admitted, to have information constantly available as to the character of the unemployed.

At present skilled labor of a type urgently required must take its turn in the quota with the result that it probably will be a year or more before the individuals wanted can be brought into the country.

Europe Must Migrate

Another factor of great national importance which is not being overlooked is the fact that the pressure of population in Northern Europe is becoming such that it must find an outlet. America at one time provided such an outlet. This excess of population in the countries of Northern Europe can be absorbed to the greatest advantage by the United States.

The first action which will be taken by the new Congress unquestionably will be the passage of the deportation law which failed to get through before the adjournment of the last session. This law is essential to a registration law or any other device to rid ourselves of aliens who are in the country illegally. A large percentage of those who enter illegally have been found to be highly undesirable additions to our population.

There is no disposition on the part of the Congressional committees to increase the quota at present. After a way has been devised for a careful selection of immigrants and proper machinery provided to determine accurately our own needs, then the size of quotas can be taken up more intelligently, it is believed. Most members of the committees are convinced that it is not sound to provide labor for any possible peak of production. This means an unemployment problem when the inevitable reaction comes. They believe it will tend to stabilize production if the labor supply will not permit of wide fluctuation in the rate of production. It will be better for all concerned, they contend, to have the labor supply at a point where it will be necessary to use it steadily in order to meet the demand for production.

The machine tool and allied industries will watch the development of this situation with more than usual interest.

National Association of Manufacturers Analyzes Decision on Trade Statistics

Finds that authorities concur with own views

The highly competent legal staff employed by the National Association of Manufacturers has analyzed the decisions of the Supreme Court on trade association activities in the Maple Flooring and Cement cases and holds that the decisions make it clear:

(1) That an association or combination of persons or corporations may fairly and openly compile and distribute timely trade information to their members or associates, providing such association or combination is not reaching or attempting to reach an agreement or arrangement to restrict production or prices, or divide territory, or otherwise artificially restrict competition among themselves.

(2) That the data which may be lawfully compiled and distributed under such circumstances may include: unidentified information as to the cost of the product, the price received for it in closed transactions, the volume of such production, the stocks on hand, and the approximate cost of transportation from the established center of shipment to the various places of consumption.

(3) That a tendency to uniform price for a standard article following the distribution of legitimate trade information merely indicates the natural operation of economic law following the exercise of a valid right. It is not in itself an index of illegal trade restraint.

(4) That such associations, or persons, or corporations within the same industry, subject to the restrictions stated, may freely meet and discuss the information thus obtained.

In addition, this statement is made: The opinion does not mean that associations previously condemned are legitimatized. It gives no license to misuse timely trade information or by any device or disguise use a trade association to artificially control production, prices or the territory of competition. It cannot be emphasized too strongly that the opinion merely affords each industry an opportunity to collectively assemble essential information which substitutes intelligent for ignorant competition. It gives each industry an opportunity to set up self government in the use of this new freedom and establish a custom which will sternly confront any threatened abuse of this valuable right. It is confidently anticipated that it will mean the growth of a common law of sound custom within each industry which will make unnecessary the further intervention of government, to prevent or regulate abuse.

No small amount of credit is due to the National Association of Manufacturers for the favorable outcome of the long controversy over trade association statistics. The first formal attempt to end the confusion over trade association statistics was made at a conference July 29, 1921, called by the National Association of Manufacturers. At that meeting correspondence between the association and Secretary Hoover was made public. The association took the position that the collection of facts relating to production, sales, shipments, stocks and prices obtained is not in violation of any federal law. It was pointed out at the same time that the use made of such information might be illegal. Following the decision in the hardwood case the association made an analytical study of trade association activities, which indicated that the great bulk of this work was in the public interest. Since that time the association has been very active in its efforts to clarify the situation.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THE light clouds that overhung the distant horizon last week are somewhat darker and are commencing to make people in this country a little more cautious. As far as one can judge from the newspapers the trouble in the Chinese treaty ports is coming to be very serious and the New York stock market was quite weak on last Tuesday afternoon upon an unconfirmed rumor that Japan had declared war on southern China.

A man who ought to know says that there is no foundation for the report, but he adds that nearly every European in the Far East thinks that it is inevitable that the Japanese should ultimately dominate China and that the wish was probably father to the thought in the mind of the press correspondent who referred to the rumor in cabling this country.

Incidentally, a rise of three cents an ounce in the price of silver, and heavy purchases of cotton goods for China were construed as indications that the Far East is getting ready for something.

Then there is the financial predicament of the French government. Francs declined to 4.58 and it is asserted that the small French investors are showing great reluctance to renew the bonds now maturing, despite the fact that the basis on which the new securities are offered is the equivalent of 8 per cent or more.

And finally the growing fear that the Van Sweringen consolidation will be held up indefinitely and that many other combinations talked of will be put on ice for a time have led to some selling of railway shares and have set people to talking about the overbought condition of the stock market, where brokers' loans are again at or near the maximum of last March, when a severe break in prices occurred.

Psychologically the stock market is ready for a decline if money becomes dearer, for although the Federal Reserve Banks have a large supply of unused credit they cannot rediscount brokers' loans and the member banks appear to have put out about all they care to lend against ineligible obligations.

But the increased conservatism noticeable in the stock market has not as yet made itself felt in commercial circles, where there has been more rather than less activity.

Raw cotton is higher on talk of boll weevil and drought. A distinct improvement is discernible in the demand for standard cotton fabrics and popular novelties. Rather more inquiry for flannels, worsteds and woolen goods is also noticeable. The grain markets are relatively quiet, but less buoyant than recently.

Rubber has advanced sharply on buying that has been limited because stocks are very small, and coffee has begun to yield to the inevitable by declining slightly. Tea and rice are both quite firm. A scarcity of rice until the new crop is available in September is statistically indicated.

The metal industries are as previously. In all lines they are working at about 70 per cent of capacity, but it is stated that some railroads have been able to buy foreign rails at less than the price here.

Taken in its entirety the country also seems to be running at from 75 to 80 per cent of its capacity. There is no boom anywhere and people have time enough to complain. But everyone is making a living and there appears to be work for all those who want it.

President Coolidge is again encouraging the hope of lower taxes, and capital is correspondingly pleased, but no one forgets that Congress will be in session early in December and coming events cast their shadows before.

But the shadows are often misinterpreted by those who are imaginative, and just at present there is a fear that some of them mean tariff revision, or lower railway rates, or an attack on the Federal Reserve System, or something else that may hurt business.

There is a curious unwillingness to believe that Congress can or will do anything that will help business, and although it is not entirely supported by the record it is true that most men abhor the changes in methods or conditions that are sometimes imposed upon them by our legislative bodies. Therefore it seems unwise to calculate upon any unusual activity in the immediate future.

The country is coming to be like the opulent man who has grown conservative as he has grown rich. There is, and for some time there has been a disposition to avoid speculation in everything but Florida lands. The wealth of the people and the abundance of credit provided through the establishment of the Federal Reserve Banks have increased the demand for interest bearing investments. The market for them seems to be almost insatiable, and there is no doubt that the ease with which such investments can be sold has made it possible to finance some highly speculative enterprises. But of speculation on the various exchanges as we used to know it there is but little and no immediate prospect of any increase.

The same statement is true of the merchandise business. The hand to mouth buying of which we hear so much reflects an effort to avoid the commercial speculation that is so much disparaged.

This depresses those who think that speculative excitement is a necessary complement of prosperity, but it is as a matter of fact highly reassuring for it keeps business on an even keel and in an almost invulnerable position.

What's Doing in Industry

The machine tool and machinery industries face the second half of the year with greater confidence than they have had during the past year. The business for the six months just closed proved to be slightly better than was at first expected. The volume for June helped to make this report possible.

The New York market showed perhaps the best business for the past week. Buying by railroads and public utility companies has stirred up unusual activity and promises good prospects for the future. Up through New England the demand is quiet, but export trade is expected to materialize very soon. The Buffalo district shows a slight improvement, with new inquiries forecasting future business.

The Mid-West continues to be active, with automotive and general industrial plants still in the market. Detroit, in the midst of one of its greatest production years, is the best customer. In Indianapolis the steel fabricating plants and farm implement manufacturers are supplying some good orders. Chicago reports some buying by the railroads, but little other activity. In Cincinnati the demand has increased noticeably and actual sales have also gone ahead.

It is the general opinion of authorities that business has assumed an air of caution, probably induced by the uncertain developments in foreign countries where civic unrest has grown to serious proportions. But it is believed that these disturbances are too far away to affect us here.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New England

Business placed with standard machinery builders in the New England district during the last ten days was less in the aggregate than in any like period for the past five or six months. Special machinery manufacturers report their orders are running about the same and the inquiry volume is good.

Makers of all kinds of machinery doing export business state that this trade continues to improve and that these requirements will offset any falling off in domestic needs.

Automotive parts manufacturers report that requests have been received for estimates on large quantities and the business represented furnishes reasons for optimism.

Buffalo

Conditions in Buffalo continue active. Not in months have there been so many inquiries out for various types of equipment in large and small lots. Business may be characterized as fair.

Most industries are going along better now than they were at any time since the first of the year. During the last few weeks many industries increased their forces and speeded up production. In the same period of time inquiries for tools increased proportionately and, while buying has not been commensurate with the number of inquiries up to the present time, conditions are believed to indicate a very bright future.

It seems quite safe to predict that in the machine tool trade the last half of 1925 will show a marked improvement over the condition of the trade in the first half of the year. And this is true of all industry as applied to Buffalo and western New York.

The demand for road building equipment still continues to keep up and there is some improvement in the demand for heavier equipment. Conditions in the railroad field remain quiet. Buying and inquiries are limited.

Indianapolis

Business in machinery continues fair in this area. It is true the demand is not as strong as the trade expected but it is nevertheless satisfactory. Some spottiness was noted last week in the automotive demand, but factories continue to operate almost to capacity.

Railroad demand is slow. There is a tendency on the part of roads operating in this state to curtail repair work. This policy of economy is apparent in many shops in the state. Naturally the buying is restricted.

A feature of the local situation is the machinery and tool demand from the fabricating plants dealing in structural steel. Due to heavy construction this year these plants are working to capacity.

A fair demand continues from farm implement manufacturers. These factories have been consistent buyers during the entire year. The last week has produced inquiries from the coal fields for special mining machinery.

Detroit

Interest of machinery and machine tool dealers in Detroit is centered upon the evidences of the trend toward permanency and stability in automobile design, together with the employment of more conservative policies by leading motor car manufacturers.

Recent announcements indicate that the day of the one-year model is passing, and that the automobile of the present has reached such a stage of perfection that only minor changes may be expected from time to time. Just what effect this trend will have on machinery used in the automotive industry is a matter of conjecture. Many machine tool leaders believe that little change will be noted from a sales standpoint.

The Pontiac Board of Education, at Pontiac, Mich., is buying all kinds of equipment, including furniture, machinery and general shop equipment for its new junior high school.

Sales in Detroit have slightly decreased, but the lull is not unexpected in view of the record-breaking performances of the automobile and accessory plants. Employment figures have kept on an even keel, a corroboration of the prosperous condition in this city's manufacturing establishments.

Cincinnati

Many of the machine tool manufacturers of Cincinnati report an increased demand during the past week; in no case is it reported that the demand was less than it was in the preceding week. Conditions are better than they were in the corresponding period of last year; the trend is upward, with orders and inquiries increasing.

Dealers in machine tools report that their sales have increased slightly during the past week, but the local market is still sluggish. The greater part of the local demand has been for smaller tools, but inquiries received are taken to indicate that there will spring up at least a fair demand for larger tools in the near future.

Some export sales are reported during the week, and it is stated that salesmen and selling agents abroad are sending in reports that are very encouraging. This demand, of course, is confined to certain improved types of machines, with which foreign makers are not in position to compete.

Railroads have been doing some buying. They are sending out a large number of inquiries, and this is taken as an indication that they need tools and must purchase soon.

The automotive industry is still buying, and there is every indication that for some time orders will continue to come from this source. Orders and inquiries come from all sections of the country.

New York

Business continues spotty in this market but the total volume is quite satisfactory. Orders closed in the last week of June helped to swell the total of that month and by many companies it is reported that June was the best month of the present year. However, the total for the first six months of 1925 does not come up to that of the same period in 1924, but it is expected that the industrial activity now in full swing will see a better business in the second half of the year just started.

Dealers in this market are greatly encouraged by the number of new inquiries that have appeared of late. This forecasts better business in the near future.

Business placed with local firms is quite satisfactory. One substantial order was from the Illinois Central Railroad and called for three car-wheel lathes, two 90-in. driving-wheel lathes, one wheel quartering machine, one locomotive axle turning lathe and a 48-in. car-wheel borer. From other sources came orders for a 42-in. boring mill, a 6-ft. radial drill, several large cranes and shop equipment of a miscellaneous character. The Long Island Railroad bought against a list submitted some time ago. This order included two lathes, two grinding machines and a drill press. The General Electric Co. was also in the market and placed orders for a small amount of equipment.

Chicago

With the exception of railroad distribution of orders, mainly those of the Illinois Central and Santa Fe roads, the Chicago machine tool industry has shown no special signs of activity during the week, and dealers are not looking forward to more than normal trade until fall.

There appears to be a slight increase in industrial inquiries, but on the whole the market is without feature worthy of note. The Board of Education has

not as yet given out its requirements for new school equipment, which will be needed by September, and which will consist principally of wood-working machine tools.

From dealers handling grinding machinery reports are to the effect that the last six months' business has proved most satisfactory, having shown a material increase over the preceding half year. There will be placed on the market this week another large lot of machinery and machine tools, consisting of 100 screw machines, 15 universal boring machines, 25 drill presses, 45 punch presses and a quantity of smaller machines. These are the property of the Chicago Automatic Machine Co. The sale will be by public auction.

Canada

Latest reports from the principal industrial centers of Canada indicate an encouraging demand for machinery and machine tools. Business generally throughout the country has shown marked improvement during the past two weeks. Most maufacturing plants are busier now than during May and a betterment is noted in the employment situation. Mining operations are in full swing throughout the country, and the pulp and paper industry is well employed. Foundries and machine shops are engaged at from 40 to 60 per cent of capacity with some shops working at full capacity.

A rather encouraging record has been established by the iron and steel industry during the past three months. The production of pig iron during May was 63,204 long tons, an increase of 5 per cent over the previous month.

The steel plant of the Algoma Steel Corporation has secured a contract for chrome steel for the Ford Motor Co. Official announcement has been made from Quebec of completion of plans for a hydro-electric development of 600,000 hp. at the Chute-a-Caron Falls in the Lake St. John district, which will include the construction of a plant for the manufacture of aluminum.

With most encouraging crop reports this year, business conditions in Western Canada are excellent.

A.S.T.M. Elects Officers

At the conclusion of its twenty-eighth annual convention which was held in Atlantic City, June 22 to 26, the American Society for Testing Materials announced the election of the following officers to serve in the ensuing year:

W. H. Fulweiler, chemical engineer with the United Gas Improvement Co., Philadelphia, was elected president, and H. F. Moore, professor of engineering materials, University of Illinois, was elected vice-president. Members of the executive committee are: Louis Anderson, Jr., chief chemist, Alpha Portland Cement Co., Easton, Pa.; E. F. Kenney, metallurgical engineer, Bethlehem Steel Co., Inc., Bethlehem, Pa.; T. D. Lynch, manager of materials and processes, engineering department Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.; and K. G. Mackenzie, consulting chemist, the Texas Co., New York.

Revision of Sizes in Roller Bearings

The possibility of a 75 per cent reduction in the sizes of taper roller bearings was discussed at a preliminary conference last week, under the auspices of the Division of Simplified Practice. The meeting was attended by manufacturers, representative users and members of the Society of Automotive Engineers.

The problem of simplification of sizes, it was disclosed by manufacturers' representatives, has been studied for some time and tentative plans are under way for the development of two sets of specifications, one for standard sizes, and the other for service purposes.

The meeting was in favor of a committee representing the manufacturers developing a tentative set of standard sizes, which will be submitted to the sub-committee on taper roller bearings of the Society of Automotive Engineers. When such action is taken, the Division of Simplified Practice will be asked to give its assistance in placing the standards before the entire field of distributors and users for the support of the latter two groups.

Industrial Engineering Course at Lehigh in Fall

Cross-breeding the engineer with the business administrator is the interesting experiment that will be launched at Lehigh University next September, according to the announcement of a new curriculum to be known as Industrial Engineering. Recognizing that every modern enterprise depends on sound financing, adequate accounting and intelligent forecasting of economic developments, the faculty at Lehigh will undertake to produce engineers as thoroughly grounded in these fundamentals of business as in their mathematics, physics and scientific subjects.

The curriculum is primarily engineering in character and will equip the student with sufficient technical knowledge to make him at home in a highly technical environment. In addition, however, it will include courses in economics and business that will be of service to those graduates who enter the less technical departments of any of the various industries which are essentially technical in character. The course will lead to the degree of Bachelor of Science in Industrial Engineering.

First Test on Lewis Gear Machine

The first practical test of the operation of the gear testing machine built under the direction of Wilfred Lewis, chairman of the special research committee on gear teeth, of the A.S.M.E., was conducted on June 16 in the mechanical engineering laboratory of the Massachusetts Institute of Technology. This machine was built with funds subscribed by engineers and organizations interested in perfecting a method of accurately testing gear teeth. The idea of a special machine for this purpose was first introduced in an article "Modern Problems in Gear Testing and a Proposed Testing Machine," by Wilfred Lewis, which appeared on page 875, Vol. 59, of *American Machinist*. The purpose of the tests are the determination of the effect of varying degrees of tooth accuracy and varying velocities on the strength of gear teeth. It is expected that the information gained in these tests will be essential in the solution of wear and noise problems.

The committee in charge of the development and construction of the machine, as originally appointed, consisted of Earle Buckingham, Ralph E. Flanders, Arthur M. Greene, Jr., Charles H. Logue, F. E. McMullen, E. W. Miller and Ernest Wildhaber. Mr. Lewis is chairman of this committee.

The test conducted on June 16 consisted in integrating the master gears which form the basis on which all tests will be made. The other part of the test consisted in running the gears under increment speeds, which shows the effect of error on various loads and speeds, including the elastic properties of the material. A final test was made to show that the efficiency of gears can be obtained under any desired condition.

The committee expressed satisfaction over the results of the tests, but stated that because of the many adjustments that must be made, including a study of all the characteristics of the machine, it is premature to make any definite statement of the work at this time.

Sweden Perfects New Type Railroad Engine

A motor railroad engine combined with a method for hydraulic transmission of power from the motor to the driving axles, which is claimed by the inventor to effect an 80 per cent saving in fuel, has just been constructed at Trollhattan, Sweden, according to consular advices to Washington.

It is reported that four such engines have been constructed for the account of a Swedish railway and will shortly be placed in operation. If the tests prove satisfactory, the manufacturers contemplate a campaign for their sales in foreign markets.

Russian Industry Booming

A thousand tractors are being built in Russia this year, and the output of agricultural machinery has doubled in the past twelve months, according to the report of F. E. Djerzinsky, chairman of the supreme economic council, to the recent Federal Congress of Soviets in Moscow. As translated by the Russian Information Bureau, Djerzinsky said:

"This year, as compared with last, we have more than a twofold increase in the output of agricultural machinery. We are running our factories at 98 per cent of pre-war capacity. Some plants are running at 8 per cent above pre-war volume, and still we are not in a position to satisfy the demands of agriculture for farming equipment."

Business Items

The Scott Valve Manufacturing Co., of Detroit, announces the appointment of H. P. Rodgers & Co., Leader-News Building, Cleveland, as the Cleveland representatives for the Scott line of bronze and iron body valves.

The offices of the Canada Machinery Agency, in Montreal, have been moved to 26 Victoria Square.

Alfred Herbert, Ltd., Coventry, England, has been appointed sales agent for the Morse Twist Drill and Machine Co., New Bedford, Mass. Stocks of carbon steel tools and threading equipment will be kept at the main and branch offices throughout England.

The Alvord-Polk Tool Co. has been organized to direct the manufacture and sale of the products of the Alvord Reamer and Tool Co., and of the A. J. Polk & Son Co., both of Millersburg, Pa.

The E. L. Essley Machinery Co., of Chicago, has been appointed sole representative in the Chicago territory for punches, shears and bar cutters manufactured by the Buffalo Forge Co., of Buffalo, N. Y.

The proposed auction sale of the plant of the New Departure Reduction Co., at Green Ridge, Staten Island, N. Y., has been indefinitely postponed.

The Prentiss Vise Co., of New York, has purchased the Henry Cheney Hammer Corporation, of Little Falls, N. Y. The Cheney plant will continue to operate as heretofore and the product will be marketed through the Prentiss organization.

Personals

THOMAS I. SHRIVER, who has been connected with the Hartford branch of Henry Prentiss & Co., has been transferred to the Syracuse office and will have charge of the territory in Scranton, Binghamton, Elmira, and Williamsport. Mr. Shriver was at one time associated with the National Automatic Tool Co.

RAYMOND B. HOSKEN has been appointed general sales manager in charge of domestic sales for the Sullivan Machinery Co., Chicago. Mr. Hosken has been associated with the Sullivan organization since 1910.

L. M. BOVAIRD has been appointed manager of the Detroit branch of the Lapeer Trailer Corporation. Mr. Bovaird was formerly a branch manager for the Mason line of products.

LEON THOMAS, chief engineer of the Andre Citroen Co., automobile manufacturer, France, has been in Detroit during the past week where he consulted with officials of the Miller-Hurst Corporation regarding the proposed new foundry for his company. Mr. Thomas was accompanied by Mr. Genot, New York representative of the Citroen interests.

D. C. BRIGGS, formerly production manager for the Detroit Steel Products Co., Detroit, has become associated with the American Forging and Socket Co., of Pontiac, Mich., as general superintendent in charge of manufacturing.

L. C. BLOOMFIELD has been elected vice-president of the Ampco Twist Drill Co., Detroit. Other officers are A. B. Connable, vice-president; and C. G. Mackay, secretary-treasurer.

JOHN H. PECKHAM, who has been covering a general territory as a grinding machine specialist for Henry Prentiss & Co., is now located at the Hartford branch office of that company. Mr. Peckham for many years represented the Norton Co. in Connecticut.

JOHN D. HURLEY, president of the Independent Pneumatic Tool Co., of Chicago, sailed from New York on July 1 on board the "Acquitania" for an extended business trip to Europe. Mr. Hurley will visit the branch offices and agencies of the company.

ERNEST TWIGG, mechanical superintendent for the Landers, Frary & Clark Co., New Britain, Conn., will sail on July 4 for Europe. He will visit England, France, Germany, Belgium and Holland.

HENRICK OWENSEN has been appointed chief engineer for the Youngstown Sheet and Tube Co., Youngstown, Ohio.

JOHN ROBERTS, of Stratford, Ont., has been appointed general shop supervisor of the Canada National R.R., with headquarters at Montreal.

B. D. QUARRIE has been appointed vice-president and general manager of the Paper and Textile Machinery Co., Sandusky, Ohio. He was formerly general manager of the Otis Steel Co.

FRANCIS A. EMMONS, advertising manager of the Foote Bros. Gear and Machine Co., of Chicago, has been elected secretary of the Engineering Advertisers Association of Chicago.

JOHN Q. HOLMES has resigned from the Remy Electric Co., of Anderson, Ind., and has become assistant to the president of the Davis Boring Tool Co., of St. Louis.

W. C. MACFARLANE has become associated with the Minneapolis Steel and Machinery Co., Minneapolis.

JOHN PROTZKY has resigned from the E. W. Bliss Co., of New York and has joined the engineering staff of the Westinghouse Electric and Manufacturing Co., at Sharon, Pa.

ROBERT P. LAY has been appointed chief engineer for the Penn Spring Works, Baldwinsville, N. Y.

HARVEY P. DAWES has resigned as assistant engineer with the Industrial Works to become mechanical engineer for the Huron Industries, Inc., Alpena, Michigan.

HERBERT S. KARCH has joined the Remy Electric Co., of Anderson, Ind., as metallurgical engineer.

R. S. GRIFFITH, who recently resigned as general sales manager of Canadian Vickers, is now sales manager of Griswold and Co., Montreal.

EMMET P. GRAY, treasurer of the Gray-Hawley Manufacturing Co., Detroit, has purchased the George E. Hawley interest in that concern and will expand the present business. He has been working on a motor car exhaust system and will manufacture it complete, including all bolts and fittings covered by patents.

Obituaries

FREDERICK F. FUESSENICH, president of the Hendey Machine Co., Torrington, Conn., died in his home in that city on June 28. Mr. Fuessenich had been associated with the Hendey organization for the past fifteen years, and was also interested in several other manufacturing companies. He was seventy-seven years old.

HERBERT S. VALENTINE, sales manager of the monorail hoist department of the American Engineering Co., Philadelphia, died at his home in that city on June 5. Mr. Valentine was the inventor of the "Lo-Hed" hoist and was well known among engineering fraternities.

C. H. WATEROUS, president of the Waterous Engine Works, of Brantford, Ontario, died at his home in Brantford on June 10. He was in his seventy-fifth year.

EDWARD S. REID, vice-president and chief engineer of the Northern Engineering Works, Detroit, manufacturers of cranes and equipment, died at his home in that city on June 13. He was an active member of the A.S.M.E. and of the Detroit Engineering Society.

Trade Catalogs

Threading Machines. Landis Machine Co., Waynesboro, Pa. A seven-page booklet. Illustrations of several types of threading machines and die-heads are shown. A great deal of the space is devoted to pictures of Landis machines in operation in several large plants.

Milling Machines. The Kempsmith Manufacturing Co., Milwaukee, Wis. Catalog C gives in condensed form the specifications and illustrations of 21 sizes and types of milling machines and attachments. Loose-leaf folders of these machines are being supplied. These folders go into considerable detail of the machines and fixtures.

Milling Machines. Kearney & Trecker Corporation. Layout No. 14, a circular discussing a particular production set-up.

Pipe Flanges and Furnaces. American Spiral Pipe Works, Chicago, Ill. Catalog No. 24 contains complete tables of forged-steel flanges, nozzles and furnaces. Each table is illustrated with a cross-section of the flange or nozzle. The section devoted to furnaces contains formulas and tables for determining the working pressure. This catalog has 86 pages of artistically arranged material bound in a stiff paper cover.

Belt Lacers. Clipper Belt Lacer Co., Grand Rapids, Mich. A circular that describes the method of operation of the clipper belt lacer and contains a table showing the size numbers of hooks to be used on belting.

Pots and Furnaces. Chicago Flexible Shaft Co., 5600 Roosevelt Rd., Chicago, Ill. A circular listing the prices of pressed-steel pots and of gas and oil furnaces, with a short description of each.

Brinell Machines. Herman A. Holz, 17 Madison Ave., New York City has issued Bulletin No. 27 on hardness testing of metals. The bulletin contains an interesting discussion of the Brinell methods, a Brinell hardness table, and specifications of the Brinell instruments.

Multiple Drills. The Ingersoll Milling Machine Co., Rockford, Ill., has sent out a folder illustrating several large multiple drills designed for automobile chassis and motor production.

Sheet-Metal Work. The Canton-Art Metal Co., Canton Ohio. A catalog devoted to special sheet-metal work, describing some of the company's products including tote boxes, waste cans, tool stands and metal guards. A section of the catalog deals with special construction work.

Gears. Niles-Bement-Pond Co., 111 Broadway, New York City. A catalog describing the Maag system of gear design. The advantages of the Maag gear are discussed and illustrations are shown of some of the products of the system.

Electric Motors. The Master Electric Co., Dayton, Ohio, is distributing a folder, No. 308, to bring out the construction features of the Master electric motors. The folder lists the capacity horse-power ratings of the motors produced.

Electric Cranes. Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Bulletin No. 80 covers the use of electric cranes and hoists in the iron and steel industry. Several illustrations are shown of each model as it has been applied to industrial problems. This bulletin contains 40 pages.

Forthcoming Meetings

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Ill., Sept. 2, 3 and 4. G. G. Macina, C. M. & St. P. Ry., 1402 Calumet Ave., Chicago, Ill.

International Railway General Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 8, 9, 10 and 11. William Hall, secretary and treasurer, 1061 W. Wabash St., Winona, Minn.

New Haven Branch of the American Society of Mechanical Engineers. Fifth annual machine tool exhibition, Sept. 8 to 11. Mason Laboratory. H. R. Westcott, chairman.

Association of Railway Supply Men. Annual convention and exhibition. Hotel Sherman, Chicago, Sept. 8, 9, 10 and 11. Earl E. Thulin, secretary, the Duff Manufacturing Co., 715 People's Gas Bldg., Chicago.

American Society for Steel Treating. Annual Convention and National Steel Exposition. Public Auditorium, Cleveland, Ohio. Week of Sept. 14. W. H. Eisenman, Secretary, 4600 Prospect Ave., Cleveland, Ohio.

Production Meeting Society of Automotive Engineers. Sept. 14, 15 and 16. In conjunction with American Society for Steel Treating. John Younger, chairman; G. F. Clarkson, secretary, 29 West 39th St., New York City.

Management Week. Conducted jointly by five societies—The American Society of Mechanical Engineers, The American Management Association, The National Association of Cost Accountants, The Taylor Society and the Society of Industrial Engineers. Week of Oct. 19 to 24. W. L. Conrad, of the A. S. M. E., is chairman of the joint committee.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Iron demand runs mostly to small tonnage lots; maximum quotation on No. 2 fdry, Southern, has dropped $1 per ton since June 19; trend, though downward, is not strongly so and possibilities of advances are remote. Scrap reported firmer in spots. In the steel market, sheets continue to occupy the weakest position. Structurals are active owing to construction demand. Tin plates are moving in seasonal volume, although slight price concessions are rumored. The principal hot rolled products average $2 per 100 lb. at Pittsburgh mills; quotations as low as $1.80, however, are heard on shapes and plates and as high as $2.10 per 100 lb. on bars.

Non-Ferrous Materials—Copper prices at June 19 level. Zinc firm; antimony scarcer. Tin is easy here and abroad. Lead market slow despite decline in output. Linseed oil rising in the West.

(All prices as of June 26)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$23.05
Northern Basic	22.27
Southern Ohio No. 2	22.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	19.00@20.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.26
Virginia No. 2	29.17
Basic	22.26
Grey Forge	22.75
CHICAGO	
No. 2 Foundry local	22.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.77
Basic	22.77
Bessemer	22.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.25@2.30	3.89	3.10	3.50
No. 12	2.30@2.35	3.94	3.15	3.55
No. 14	2.35@2.40	3.99	3.20	3.65
No. 16	2.45@2.50	4.09	3.35	3.80
Black				
Nos. 17 to 21	2.90@3.00	4.15	3.90	3.80
Nos. 22 to 24	2.95@3.05	4.20	3.95	3.85
Nos. 25 and 26	3.00@3.10	4.25	4.00	3.90
No. 28	3.10@3.20	4.35	4.10	4.00
Galvanized				
Nos. 10 and 11	3.15@3.25	4.35	4.10	4.00
Nos. 12 to 14	3.25@3.35	4.45	4.20	4.10
No. 16	3.40@3.50	4.60	4.35	....
Nos. 17 to 21	3.55@3.65	4.75	4.50	4.40
Nos. 22 to 24	3.70@3.80	4.90	4.65	4.55
No. 26	3.85@3.95	5.05	4.80	4.70
No. 28	4.15@4.25	5.35	5.10	5.00

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	59½%	48%
3½ to 6 in. steel lap welded	48%	35%	53½%	40½%	56½%	45%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%, less 5%; class A, plus 23%. Cast iron, standard sizes, 36% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ¼-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
¼	$0.09	50%	⅞	$0.16	35%
⅜	.11	45%	1	.18	31%
½	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	....	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.05	8.00	7.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.35	8.25	7.85
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	3.80	3.80
Cold drawn flats, squares	4.65	4.30	4.30
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb. Chicago, 3/32, 8.85c.; 5/32, 7¾c.; ⅛, 7.95c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			14.12½
Tin, 5-ton lots, New York			56.62½
Lead (up to carlots) E. St. Louis	7.85	New York	8.62½
Zinc (up to carlots) E. St. Louis	7.00	New York	7.75

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	18.00	19.00	....
Copper sheets, base	21.75	21.75	22.00
Copper wire, base	19.25	16.00	20.00
Copper bars, base	20.87½	20.75	22.50
Copper tubing, base	23.75	24.75	24.00
Brass sheets, base	18.12½	18.62½	18.37½
Brass tubing, base	22.75	25.25	26.00
Brass rods, base	15.87½	16.37½	18.37½
Brass wire, base	18.62½	20.12½	20.00

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1–15 ton lots	28.00	28.00	27.00
Zinc sheets (casks)	11.25	11.25	11.37
Solder (½ and ½), (case lots)	39.50	36.50	.....
Babbitt metal (83% tin)	60.00	65.00	50.00
Babbitt metal (35% tin)	28.00	20.50	28.00
Nickel (ingots) f.o.b. refinery	31.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	38.00	.....	.....
Nickel (shot) f.o.b. refinery	32.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.00@11.50	11.25	1..25
Copper, heavy, and wire	10.75@11.00	11.00	10.75
Copper, light, and bottoms	9.25@9.75	9.00	9.25
Heavy lead	6.00@6.25	6.25	..25
Tea lead	5.00@5.25	3.75	4.50
Brass, heavy, yellow	6.75@7.25	6.50	6.75
Brass, heavy, red	8.50@8.75	8.75	8.75
Brass, light	5.75@6.00	5.50	5.75
No. 1 yellow rod turnings	7.25@7.50	7.00	7.25
Zinc	4.00@4.25	3.50	3.75

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.00
"A" Grade:				
IC,	14x20	8.85	9.40	8.50
	Coke Plates—Primes.			
100-lb.,	14x20	6.50	6.10	6.50
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.25	6.95	6.75

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.14
Cotton waste, colored, per lb.	.10@.15½	.18	.09½
Wiping cloths, 13¼x13¼, per lb	.17¼	36.00 per M	.11*
Wiping cloths, 13¼x20½, per lb.	.....	45.00 per M	.11*
Sal soda, per 100 lb. keg	2.25	2.25	2.00
Roll sulphur, per 100 lb. keg	3.60	3.75	2.85
Linseed oil, per gal., 5 bbl. lots	1.07	1.24	1.23
Lard cutting oil, 25% lard, per gal.	.55	.50	.32
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.21
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	30–10%	30–10%	30–10%
Heavy grade	20–5%	20–5%	20–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50–5%	50–10%	60%
Second grade	50–10–5%	60–5%	65%

*White, at washery.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0334
Cold finished shafting	per lb.	.0415	.0415	.044
Brass rods	per lb	.1587½	.1587½	.14
Solder (½ and ½)	per lb.	.395	.395	.3475
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	30–10%	30–10%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	50%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$4.86	$5.84	$5.00
Emery paper	10.71	11.00	11.00
Emery cloth	28.00	31.12	32.75
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.24	1.50
Cloth	3.38	2.67	3.55
Fire clay, per 100 lb. bag	.....	.65	.75
Coke, prompt furnace, Connellsville	per net ton		2.85@3.00
Coke, prompt foundry, Connellsville	per net ton		3.75@4.25
White lead, dry or in oil	100 lb. kegs		New York, 15.75
Red lead, dry	100 lb. kegs		New York, 15.75
Red lead, in oil	100 lb. kegs		New York, 17.25

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1½ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%. Machine bolts, up to 1x30-in., with cold punched and hot-pressed hex. nuts, also button head bolts with hex. nuts are $3.50 per 100 lb at Cleveland.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x¼in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses; with hex. heads, $4.65 per 100 lb. net at Chicago.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for ⅜-in. and smaller and 65% for ½-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam.x2½-in. to 4½-in., $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, ½x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c., longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Calif., Berkeley—Bd. of Education, M. C. James, Secy.—No. 2 Norton universal tool and cutter grinding machine.

Conn., Hartford—Dept. of State Police, 100 Washington St.—miscellaneous tools for garage.

Mass., Boston—E. Stone, 53 State St.—miscellaneous tools and equipment for extensive repair and service garage at 391 Highland Ave., Somerville (Boston P. O.).

Mass., East Boston (Boston P. O.)—T. Caputo, 33 Gladstone St.—tools and equipment for repair garage.

N. Y., Oswego—Fitzgibbons Boiler Co.—two 15 ton electric overhead cranes.

O., Columbus—The Eureka Avenue Lumber Co., Eureka and Pennsylvania Aves. (mill workers), J. A. Andrew, 38 South 6th St., Pur. Agt.—1 double drum sander for woodworking mill.

Pa., Johnstown—Bd. of Education—machinery for woodworking and vocational depts.

Pa., Pittsburgh—U. S. Coal & Coke Co., Carnegie Bldg.—planer for plant at Gary, W. Va.

Wash., Tacoma—Hofsted-Gazecki Machine Works, 2102 A St.—36 in. gear cutter (used).

W. Va., Parkersburg—Bd. of Education—vocational school equipment including woodworking and other machinery.

Wis., Baraboo—Sauk Co., W. Halbersleben, Highway Comr.—machinery for repairing highway equipment.

Wis., Milwaukee—Central Bd. of Purchases—one 10 ton caterpillar type, revolving crane.

B. C., Vancouver—American Can Co., Railway St.—can making machinery.

Que., Acton Vale—R. Guilbert—lathe, compressor and miscellaneous tools for garage and repair shop.

Que., Acton Vale—J. E. Vincent—machinery and equipment for sash and door manufacturing plant.

Que., Magog—D. Audet, 1st Pierre St.—sawmill machinery.

Que., Montreal—Autogenous Welding Co., 121 St. Augustin St., A. Devroede, Pur. Agt.—welding and cutting apparatus.

Que., Pointe Claire—Garage Pilon, U. Pilon, Purch. Agt.—miscellaneous tools and equipment for auto repair shop.

Que., Rimouski—O. Beaupre, St. Adamar Co.—sawmill machinery and equipment.

Que., St. Jerome—E. Meunier—sash and door machinery.

Que., St. Laurent—A. Bonin, 74 Principale St.—tools and equipment for repair and service garage.

P. I., Manila—G. Puyat, 233 Solana St., Walled City, manufacturer of furniture, pool and billiard tables, desires to receive prices, catalogs, terms, etc., from American manufacturers of equipment for making laminated wood, furniture and builders' supplies, locks, hinges, hasps, springs or ratched hinges for controlling the movement of cabinet doors, etc., and all commodities of similar character.

Opportunities for Future Business

Calif., Fresno—State Highway Comm., Forum Bldg., Sacramento, will receive bids until July 13th for the construction of a maintenance shop and truck shed.

Calif., Oakland — Willys-Overland Co., 1299 Bush St., San Francisco, plans the construction of an auto assembling plant here. Estimated cost $150,000. Austin Co. of California, 244 Kearny St., San Francisco, Archt. and Engr.

Calif., San Fernando—Morton Organ Co., Van Nuys, awarded contract for the construction of a 207 x 247 ft. factory on Sherman Way here. Estimated cost $65,000.

Calif., San Francisco—Pacific Box Factory, Inc., Beach and Taylor Sts., awarded contract for the construction of a 2 story box factory, first unit, on North Point St., to replace fire loss.

Conn., Bridgeport—B. B. Sheedy, 17 West 73rd St., New York, is having plans prepared for the construction of a 60 x 225 ft. repair and service garage at State and Courtland Sts. here. Estimated cost $100,000. J. W. Northrop, 211 State St., Archt.

Conn., Hartford—Dept. of State Police, 100 Washington St., is receiving bids for the construction of a 1 and 2 story, 55 x 145 ft. garage and repair shop on Washington St. Estimated cost $65,000. Buck & Sheldon, Inc., 60 Prospect St., Archts. and Engrs.

Conn., New Haven—Sargent & Co., Water and Wallace Sts., has had plans prepared for the construction of a 60 x 210 ft. plant for the manufacture of hardware on Water St. Estimated cost $75,000. Westcott & Mapes, 139 Orange St., Archts.

Every one of these items is reported by our authorized correspondents who are instructed to verify every item sent in. This free weekly service is published in the interests of the buyer and the seller, to bring them together and get machinery moving.

Everything possible is done to insure authenticity and timeliness.

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BUSINESS NEWS DEPARTMENT
Tenth Ave. at 36th St., New York

Conn., Waterbury—French Mfg. Co., 128 Robbins St., awarded contract for the construction of an 80 x 265 ft. plant for the manufacture of small tubing on Grandview Ave. Estimated cost $125,000.

Ga., Warsaw (Jones P. O.)—Twin Tree Lumber Co., Hopkins, plans the construction of a mill 20,000,000 ft. daily capacity here.

Ind., Alexandria—Banner Rock Products Co., will soon receive bids for the construction of a 160 x 200 ft. plant for the manufacture of mineral wool products to replace fire loss. Estimated cost $50,000.

Ind., Hammond—The Hammond Brass Works, J. I. Lammering, Vice-Pres., awarded contract for the design and construction of a 1 story, 90 x 320 ft. brass foundry, including a machine shop on Summer St., to Austin Co., 16112 Euclid Ave., Cleveland, O., Engrs.

Mass., Boston—S. M. Howes Co., 509 Medford St., Charlestown, is having plans prepared for the construction of a 3 and 4 story factory on Medford St. here. Estimated cost $100,000. Fay, Spofford & Thorndike, 200 Devonshire St., Engrs.

Mass., Framingham — Barber-Colman Co., River and Loomis Sts., Rockford, Ill. (manufacturers of textile machinery, hobbing machinery, hobs, milling cutters, etc.), awarded contract for the design and construction of a 100 x 120 ft. branch office and service building, to Lockwood, Greene & Co., 24 Federal St., Boston, Engrs.

Mass., Lynn.—Central Motors Co., 20 Mt. Vernon St., awarded contract for the construction of a 40 x 175 ft. sales and repair shop on Mt. Vernon St. Estimated cost $50,000.

Mass., Newton (Boston P. O.)—Newton Centre Garage, Inc., c/o N. Appleyard, 729 Beacon St., is receiving bids for the construction of a 2 story repair and service garage at 729 Beacon St. Estimated cost $125,000. Ritchie, Parsons & Taylor, 15 Ashburton Place, Boston, Archts.

Mass., Sommerville (Boston P. O.)—I. Myers, 84 State St., Boston, will build a 200 x 210 ft. repair and service garage at Dover and Meacham Sts. here by day labor. Estimated cost $75,000.

Mass., Willimansett (Holyoke P. O.)—B. F. Perkins & Son, Inc., Holyoke, has awarded contract for design and construction of a 2 story, 80 x 150 ft. pattern storage building and an 80 x 260 ft. machine shop to Lockwood Greene & Co., 24 Federal St., Boston, Engrs.

Mich., Ypsilanti—Ypsilanti Foundry Co., J. H. Lonsky, Pres., awarded contract for the design and construction of a 2 story, 150 x 160 ft. machine shop to Austin Co., 1954 Penob Bldg., Detroit.

Mo., Kansas City—Water Bd., W. B. Buchholz, Chn., City Hall, plans the construction of a repair station and training school for fire department. Estimated cost $190,000. Architect and engineer not selected.

O., Cleveland—Sterling Brass Co., S. Well, Pres., 9600 St. Catharine Ave., is receiving bids for the construction of a 2 story, 40 x 125 ft. factory and warehouse. Estimated cost $50,000. A Sogg, 3030 Euclid Ave., Archt.

Pa., Philadelphia — Atlas Electric Co., 1218 Hamilton St., awarded contract for the construction of a 2 story, 56 x 72 ft. repair shop at 916 Green St.

Pa., Williamsport—Bd. of Education, J. A. Shoemaker, Chn., will receive bids until June 30th for equipment for industrial departments including machine, pattern making, cabinet making and electric shops for vocational training.

Pa., Williamsport — Crooks-Ditmar Co., Day St., awarded contract for the construction of a 340 x 385 ft. plant for the manufacture of Cromar flooring. Estimated cost $200,000.

Tex., Beeville—Grunders Industries, Inc., is having plans prepared for the construction of a 160 x 396 ft. warehouse and machine shop. Estimated cost $60,000. Architect not announced.

Wash., Seattle—Hofius Steel & Equipment Co., L. Hofius, Pres., First Ave. South and Hudson Sts., awarded contract for the design and construction of a 100 x 320 ft. structural shop to Austin Co., 16112 Euclid Ave., Cleveland, O., Engrs.

Wis., Baraboo—Sauk Co., W. Halbersleben, Highway Comr., is receiving bids for the construction of a 42 x 100 ft. repair shop. H. E. French, City Hall, Archt.

Wis., Racine—Standard Foundry Co., 1600 Kewaunee St., is receiving bids for the construction of first unit of foundry. Estimated cost $125,000. A. Wickland & Co., 5 South Wabash Ave., Chicago, Ill., Archts. and Engrs.

Wis., South Milwaukee—Line Material Co., awarded contract for the construction of a 2 story, 80 x 200 ft. addition to plant for the manufacture of street lighting material.

B. C., Vancouver—American Can Co., Railway St., will build a 5 story, 104 x 204 ft. can factory on Railway St. by day labor. Estimated cost $475,000.

Ont., Niagara Falls—Aluminum Co. of America, plans the construction of a plant here.